TELEPHONE ENGINEER

VOLUME XXVI DECEMBER, 1922 Number 12

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How Bell Policy Plans Service

President of the Bell Tells Commissioners of the Fundamental Principles of His Company—Value of National Service—It's Extension—Complex Problems

By H. B. Thayer

(President American Telephone & Telegraph Company)

Telephone regulation and the status of the telephone industry were covered from three viewpoints at the annual convention of the National Association of Railway and Utilities Commissioners held at Detroit in November.

With H. B. Thayer, the Bell president, F. B. MacKinnon, chief of the Independent Assn. and Clyde M. Reed, Chairman of the Public Utilities Commission of Kansas, as featured speakers, the telephone industry and its problems was subjected to a penetrating analysis.

The addresses on the telephone industry by Messrs. Thayer and MacKinnon are printed in this issue of TELEPHONE ENGINEER. Mr. Reed's address will appear in a later issue.

In your broad consideration of telephone service in its relation to the public it is undoubtedly important that you should consider the application of fundamental principles and the soundness of theories which might have a bearing upon the subject. Study of the relative economies and efficiencies of large operating units and small ones, of the waste in competition and how far it can be obviated—of the danger in monopoly unregulated and to what extent it exists if regulated, comes within that field.

Competition and monopoly are human agencies. Like most human agencies they have potentialities in them for good or for evil, but the human element in them must be taken into account as well as the theories. The results of the operation of these agencies are beneficent or otherwise accordingly as they are directed—accordingly as the potentialities for good or evil are developed. I have strong opinions as to the relative values of these agencies as applied to communication and transportation services, which I think are in accord with the drift of public opinion, but my opinions cannot possibly be of as much value as facts in helping you to reach a conclusion.

If I can contribute anything to this discussion, it will be by telling what the methods of the Bell system have been and are, what it has done and hopes to do, and how it has accomplished what has been accomplished. If the motives seem to you to be worthy and the results to be good, it may help you to consider whether the method has been the best.

The telephone business is a very young business. The first man who ever spoke over the telephone was living when I received your invitation to come here. The first man who ever heard a spoken word over the telephone line is still living. Its history has not acquired the obscurity of a remote past. A large part of that history in this country has been the history of the Bell organization.

Bell Visioned Future

From the very beginning a general plan has governed the policies of that organization which appears in its records and publications. Beginning in 1878 and before there was a telephone exchange in existence, Professor Bell's vision of the future was given in a statement to intending investors. He said:

"It is conceivable that cables of telephone wires could be laid underground, or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, etc., etc.—uniting them through the main cable with a central office where the wire could be connected as desired, establishing direct communication between any two places in the city.

"Such a plan as this, though impracticable at the present moment, will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe in the future wires will unite the head offices in different cities, and a man in one part of the country may communicate by word of mouth with another in a distant part.

"I am aware that such ideas may appear to you Utopian and out of place, for we are met together for the purpose of discussing, not the future of the telephone, but its present.

"Believing, however, as I do that such a scheme will be the ultimate result of the telephone to the public, I will impress upon you all the advisability of keepng this end in view, that all present arrangements of the telephone may be eventually realized in this grand system."

If we analyze the early contract relations of The American Bell Telephone Co. with the operating telephone companies which were its licensees and with the Western Electric Mfg. Co., it becomes very apparent that they were based upon the assumption that its function was intended to be to provide a national telephone service. The company undertook 40 years ago in these contracts to provide not only instruments, but also a system of intercommunication between territories and to perform certain general services necessarily going with the development and management of a national system.

Again, the charter of The American Telephone & Telegraph Co. taken out in March, 1885, shows that the company had in mind the establishment of a national service.

"The general route of the lines of this association, in addition to those hereinbefore described or designated, will connect one or more points in each and every city, town or place in the state of New York with one or more points in each and every other city, town or place in said state, and in each and every other of the United States, and in Canada and Mexico; and each and every of said cities, towns and places is to be connected with each and every other city, town

or place in said states and countries, and also by cable and other appropriate means with the rest of the known world, as may hereafter become necessary or desirable."

The purpose consistently followed through has been the creation of a national as distinguished from a sectional service.

Now let us think for a moment of how this country of ours differs from any other in the world. It covers an immense area, and but one language comparatively free from dialects is generally spoken. In government, it is a confederation of states, but our state boundaries are no barriers to commerce. There are no customs frontiers between the states. Contrary to the case of most other countries, it is the exception here when a man lives where his father or grandfather lived, and, I think, we could almost say that it is the exception when a man lives in the same state as the one in which his grandfather lived.

This has been a nation of pioneers and colonists with the result that more than in any other country families are separated so that, more than any other area in the world of similar size, it is one country, one people with far-reaching commercial and domestic relations. It follows that such a nation must have a complete telephone service covering the whole country—a service that has no narrower boundaries than the boundaries of the nation.

A national service can exist only through an organization which provides for a uniform policy and coordinated action. Uniformity of policy and co-operation comes to the Bell system through contract relations and community of ownership. The American Telephone & Telegraph Co. owns directly or indirectly all of the voting stock of 14 associated companies, 78 per cent of nine others and 31.5 per cent of two others. The associated companies are responsible for telephone service in 5,848 communities and operate about 9,000,000 stations out of a total in the country of about 14,000,000.

There is no autocratic control of the system. Its government is more like that of a republic. The policies and problems are carefully considered in view of the local conditions and under nation-wide conditions. They are discussed in common by those in the business having only nation-wide responsibilities and by those having also direct local responsibilities. When the conclusions are reached, they are the conclusions of the Bell system. The policies established become the policies of the Bell system.

In operation, the associated companies are autonomous. In the organization of each associated company, the plan is to centralize as little as possible except in the establishment of policies and methods—to leave in the organization of each community the greatest amount of authority and responsibility for operation—to get the greatest economy and efficiency and satisfaction to the public, unhampered by any unnecessary reference to higher officials in the company.

A national telephone system could not be embraced in one corporation on account of the wide variation in corporation laws in different states. That being the case, in structure it is necessarily an organization of corporations, one of them exercising certain general functions, for the benefit of others.

Says History Proves Value

Its history proves that in the operation of this organization all other considerations have been subordinated to the development and improvement of its public service. Its program has been one of attempted foresight and anticipation of public requirements extending through all of the necessary steps—construction and maintenance of a sound financial structure, the first essential to service, continual study of the future as to requirements and possibilities of meeting them, construction of adequate plant and the maintenance of an adequate personnel.

The road by which the Bell system has progressed has not been like a city street where the traveller could find on either side supplies suited to all his requirements. The journey has been more like blazing a trail through the wilderness. You will recall that when the telephone was new, the commercial and domestic uses of electricity were limited to the simplest form of the telegraph and electric bells. Every telegraph operator knew as much about useful applications of electricity as the college professor.

Let me give you a picture of the conditions by reading to you extracts from the recommendation for the building of the first commercial long distance line:

May 12, 1885.

"The successful operation of the experimental circuit between New York and Boston has demonstrated that the telephone is a practical instrument for transmitting messages over long distances. . . . .

"There are, however, a number of mechanical, electrical and financial problems still to be solved before that success can be achieved. . . .

"Highway lines of the size and character required for this work have never before been attempted. . . .

"The telephone seems to require a non-magnetic material in the line. Copper is the only available metal, and its use . . . is still experimental. The results, so far, are highly satisfactory, but only time and experience will determine its lasting qualities and the best methods for its manufacture and use.

"We know that a one-metallic circuit can be operated between New York and Boston, but we do not know that additional parallel circuits can be successfully worked; we have reason to fear that they cannot be if constructed in the ordinary way.

"To run a number of circuits between and into large cities involves the use of both aerial, underground and submarine cables to a very large extent. There seems to be a wide diversity in the opinions of electricians and manufacturers, both as to the practicability of working through long cables and as to the size of conductors, nature and thickness of insulation, etc., which will secure the best attainable results. . . .

"The switchboards now in use are all planned for single-grounded circuits, and it will be necessary to arrange special apparatus for our circuits.

"It will be for many reasons desirable to introduce at the outset of our long distance business, a transmitter adapted in qualities and form to the requirements of this service, and to know as definitely as possible what kind and amount of battery will give the best results. . . .

Problems were so far solved as to make possible the building and opening of the first commercial line which was built from New York to Philadelphia. Problems were subsequently solved which made it possible to carry a line from New York to Boston and then one to Chicago and then to carry it on to Denver and then to the Pacific Coast.

After the sleet storms of last winter, telephone conversation was carried on between Boston and Pittsburgh through cables. It was only by the solution years before of very difficult problems that that was made possible.

By the growth of cities and the increase in the use of the telephone the number of stations within the limits of a single city has mounted in several cases to over a hundred thousand and in one case to over a million, and the number of central offices within a city to over one hundred. Under one roof as many as 20,000 lines are switched. Some central offices are now planned for more than double that number. The accomplishment of these results with a continually improving service has presented problems.

I am not going to rehearse what these things meant in the way of development, research, manufacturing plants, new types of construction, improved methods of operation or, in fact, in any of the ways which you

have undoubtedly heard rehearsed in evidence, but I want to call your attention to one thing of great importance, vital to the development, and which may have escaped your notice.

As other lines of electrical work developed—electric light and power and heating, transportation—it has often happened when our people have come to a decision as to a necessary improvement in our art, that we have found that in one of the other arts, or in college laboratory, or in the telephone business not controlled by us, inventions have been made and patents have been taken out, of which some claims might be interpreted in a way to interfere with our future progress or covering inventions which might be of value in operation.

As to have undertaken to provide a free path for the development of the business, that has involved the expenditure of millions in the acquisition of patent rights or licenses from others, in addition to the millions that we have had to expend ourselves on development, research and experiment.

It was in line with that same policy of providing a free path in which progress would be unhampered that in the early days we made the manufacturing arrangement with the Western Electric Co. In other public services the manufacturers make what they think is needed, and they control the patents upon their output. The Western Electric Co. makes what we know we need, and we control the patents.

As I have said before, we have gone beyond the point of having a purpose to establish a national service. There is a national service. Its maintenance is a responsibility—yours and ours. The responsibility upon us covers extensions into the fields wherever population develops.

Bounds Extensions

It does not involve, to my mind, extension of direct operation by us into the fields now served by others, nor does such extension seem to me to be desirable, except when greater efficiency or economy or better service point clearly to such a move. It does involve connection with the companies serving such fields. There are 9,290 connection companies. In a few of these the associated companies have a direct financial interest. In the most of them they do not.

The relation between the associated companies and the connecting companies is mutually helpful, and the tendency is all in the direction of standardization on the things which make for good service. They are a very important part of the national service serving over 4,500,000 stations.

In a few localities two companies are attempting to serve the same community. That means neither serves it wholly. It must mean either partial service or two charges for the users in that community. The public and you, gentlemen of the commissions, have repeatedly indicated your belief that such a condition is economically unsound and against the public interest. Whenever the desire of the public that such a condition shall be eliminated shall be expressed through you, the public's representatives, we shall feel under an obligation to do our part with your approval in endeavoring to remedy that condition.

The policy of the system is very simple. The fact that we are the servant of the public is fundamental. We must satisfy and please our master. All of our efforts must be directed toward what will produce that result. We must give good service. The only test we can apply to any practice or project under consideration is to resolve the question as to whether it is for the betterment of the service.

We believe that the public wants the best service that we can give, that it is satisfied to pay a fair price for good service and does not want, in the settled communities, anything less than a dependable service at any price.

From the fact that the sender of a telephone message is himself waiting when there is a delay in furnishing service—that he is, therefore, personally experiencing an inconvenience—he is more critical of bad telephone service than of any other bad service; or putting it conversely, the public expects a higher standard of service from the telephone company than from any other service because it is the public's reliance more than any other in times of commercial or domestic emergency.

To give that kind of service we must pay wages which will attract and hold a picked lot of people, and we must stimulate in them an enthusiasm for the business. They must know what we are trying to do and be in sympathy with it. We consider it as much a part of our work to foster a spirit of service among the people in our business as it is to furnish poles and wire.

There is no organization for giving telephone service elsewhere which very closely resembles the one I have been describing—it is a purely American institution. Before we attempt to decide whether it is a good institution or the best for its purpose, let us see what it has accomplished.

There is a development of one telephone to every eight persons in this country so distributed and interconnected that a telephone is practically within reach of every human habitation or place of business in the country for communication with any other, every hour of every day and night.

Nowhere else does such a condition exist. Europe has over four times the population of the United States; it has less than half the number of telephones. Great Britain has fewer telephones than Greater New York. Germany has only three telephones per 100 inhabitants. France has about one per 100, having less telephones than the state of Michigan, though having ten times the population. Detroit has more telephones than Brussels, Liverpool, Budapest, Rome, Amsterdam and Marseilles combined, with about one-fifth of the population.

Except in the more important places in foreign countries, the telephone service is not a 24-hour service. In Switzerland, in some ways an example of the best service in Europe, on week days 96 per cent of the telephone exchanges are closed at 8:30 p. m.; 23 per cent are open from 7:45 a. m. until 12:15, then close an hour and three-quarters, open again until 6 p. m., close an hour and a half, and finally open at 7:30 p. m. for half an hour, when the shutters are put up for the night, while on Sundays and holidays the service is even more restricted.

The difficulties of telephone service increase in more than direct ratio with the development. There is no public which exacts as high a standard of service as the American public. I believe that my statement will be unquestioned, that the difficulties in the way of giving a satisfactory telephone service are for the foregoing reasons greater by far in this country than anywhere else. Yet I am confident that nowhere else is the public so near to satisfaction with its telephone as here.

Increasing Value of Service

With the potentiality for connection with a continually-increasing percentage of a continually-increasing population, the value of service has continually increased.

If we take the present value of the dollar, measuring it by what it will purchase at the present average wholesale price of commodities, the average charge for telephone service is more than 10 per cent lower than in 1914; although using that same present value of the dollar we pay over 15 per cent higher wages than we did

then, so that I am justified in saying that although we are paying more for material—more for labor—we are giving more value in service, for less real money, now than before the war.

Since the beginning of this century, the population of this country has increased 45 per cent. The investment in railroad plant and equipment has increased 135 per cent. During that period we have been obliged to increase the investment of the Bell telephone plant 960 per cent to take care of an increase in the number of telephones of 1,240 per cent.

The purpose, methods and policies I have described have produced the best service, the greatest development and the best satisfied public in the world. That is not my opinion alone. It is the general opinion here and abroad. I assume that it is your opinion.

Now then when we consider any change we must have it in mind that it is a change from what has produced the best known result in its line of work. We do not rest on that result. We are looking for something better than the best. But if we—all of us, you of the regulation and we of the management—should abandon or displace proven methods for visions we could not escape a very definite responsibility to the nation.

As to regulation of such a system as we are dealing with, I assume that you do not expect me to discuss the general principles of regulation which apply to all public services, but only to present our point of view on some of the special problems which arise in your regulation of Bell companies.

There is a strictly community service furnished by the telephone and a state service and an inter-state service. The same terminal stations used in the community service are used or usable in the state and interstate services; other parts of the plant and the service of personnel used in the community service are used or usable in state and interstate service.

When it comes to the regulation of charges, it is sometimes by communities, sometimes by states and sometimes by the Interstate Commerce Commission, according to the laws of the states and of the nation as they exist.

Regulation Difficulties

Except with reference to interstate toll rates, the regulation is under state laws and generally by state commissions, so that you, gentlemen of the state commissions, are confronted with the problem of considering the value to your constituents of development outside your states, and the cost of service to your public, part of which is rendered beyond your jurisdiction and, furthermore, some of the companies serving you perform some of their functions outside the state and have other functions performed for them by another company outside your jurisdiction.

These difficulties come out of the fact that your jurisdiction is necessarily limited to your states, while telephone service cannot be limiteed by state boundaries. They introduce into the expenditures of these companies, subject to your regulation, certain general charges covering necessary services of great value, but of such a nature that precise values cannot be easily ascertained, so that the charges can be verified only as less than value received.

While you are circumscribed to a state point of view, if, in arriving at your conclusions, you think it advisable to study the financial results of the national system, it is possible for you to do so. Sworn statements of each company forming a part of the national operating organization, including the American Telephone & Telegraph Co., are matters of public record filed with the states and with the Interstate Commerce Commission, and a compilation of those statements, eliminating only inter-company transactions so as to present the operations of the organization as a whole, is presented annually in the report of the American Telephone & Telegraph Co.

The license contract between the American Telephone & Telegraph Co. and the associated companies was intended to afford, and has afforded, the basis absolutely essential to a national telephone system. Aside from all questions of economy and efficiency, a national universal service could not be provided at all by a large number of uncoördinated local units. As a part of its plan, the contract provides in general terms for such services to the associated companies as can be most economically and efficiently rendered by one central agency. It includes the obligation on the part of the American company to construct, operate and extend the long distance lines connecting the various companies into an harmonious national operating unit.

The payment under this contract of 4½ per cent of the revenue to the American Telephone & Telegraph Co. is not a levy of tribute. It is an apportionment among the state services of the compensation which must necessarily be paid for the extremely valuable benefits which they receive from the national organization.

Logical operating divisions are not bounded by state lines. A division between national and sectional toll lines cannot follow state lines. The undertaking by the national organization to construct, maintain and extend the long lines is not a device for taking away from the state organizations the cream of the toll business. The long lines form one part of the national machine, designed to handle such long distance service as may be most efficiently and economically provided through this means, and so designed to make the national machine as a whole operate most efficiently and economically.

What 4½ Per Cent Contract Means

The purpose of this contract is to provide a national universal service which shall be as efficient and economical and of as high standard as is attainable. It provides that all services essential to that end shall be rendered to the associated companies for a compensation adjusted upon an equitable basis.

The license contract is usually between two companies in which there is a community of interest, although when the contracts were originally made this was not true, the parties then being entirely independent of each other and dealing at arm's length. The present relations between the companies suggest that you closely scrutinize these contracts. The American Telephone & Telegraph Co. does not object to such scrutiny; on the contrary, it is constantly inviting it. Contracts made between corporations subject to a common control are not illegal. If close scrutiny develops the fact that they are fair, they must be accepted. It is only where such scrutiny shows them to be so unfair as to demonstrate an abuse of the relations between the parties to the material injury of one of them that the injured party may complain.

Concretely, whether any license contract of the Bell system is unfair to the licensee or whether its effect is to work serious injury to the licensee, is a legitimate matter of inquiry, but the inquiry is as to the effect of the contract upon the licensee, not as to its effect upon the American company; and if such inquiry develops that the contract is beneficial to the licensee, that the benefits received by the licensee under it not only exceed the payments which it makes, but are to be evaluated at many times the amount of such payments, then the contract stands upon the same basis as any other contract.

Of whatever the Bell system has accomplished in the way of realization of its ideal of a national service or in the way of improvements in the service or economies in the service, the public is the beneficiary. The license

(Continued on page 31)

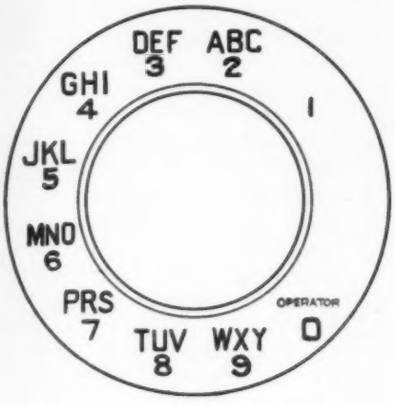

Figure 1

THE AUTOMATIC DIRECTOR IN STROWGER METROPOLITAN TLEPHONE SYSTEMS HAS INTRODUCED THE NEW DIAL, SHOWN AT RIGHT.

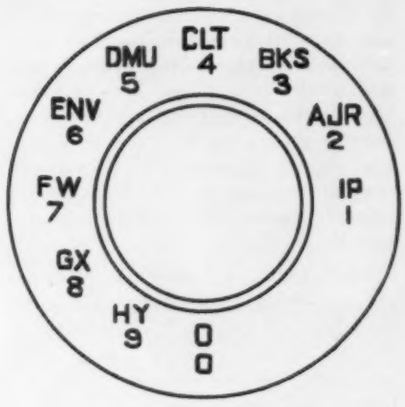

Figure 2

"DIRECTOR" NEW AUTOMATIC UNIT

Chicago, Ill.—Through the joint efforts of the research and development staffs of Automatic Electric Co. of Chicago, and the Automatic Telephone Manufacturing Co., Limited, of Liverpool, a new unit of automatic equipment, known as the Director, is now available. The Director, an assembly which consists of several pieces of standard Strowger apparatus, provides features which are sometimes very desirable in large and complex metropolitan exchange areas.

For the convenience of those interested in the Director and its application to the service and traffic requirements of metropolitan areas, demonstration laboratories have been established at Chicago and London, where complete demonstrations of this system may be made by appointment.

A complete and detailed exposition of the purpose and usefulness of the "Director" would necessarily involve a very highly technical discussion. Here, however, only the very general aspects of its application will be considered.

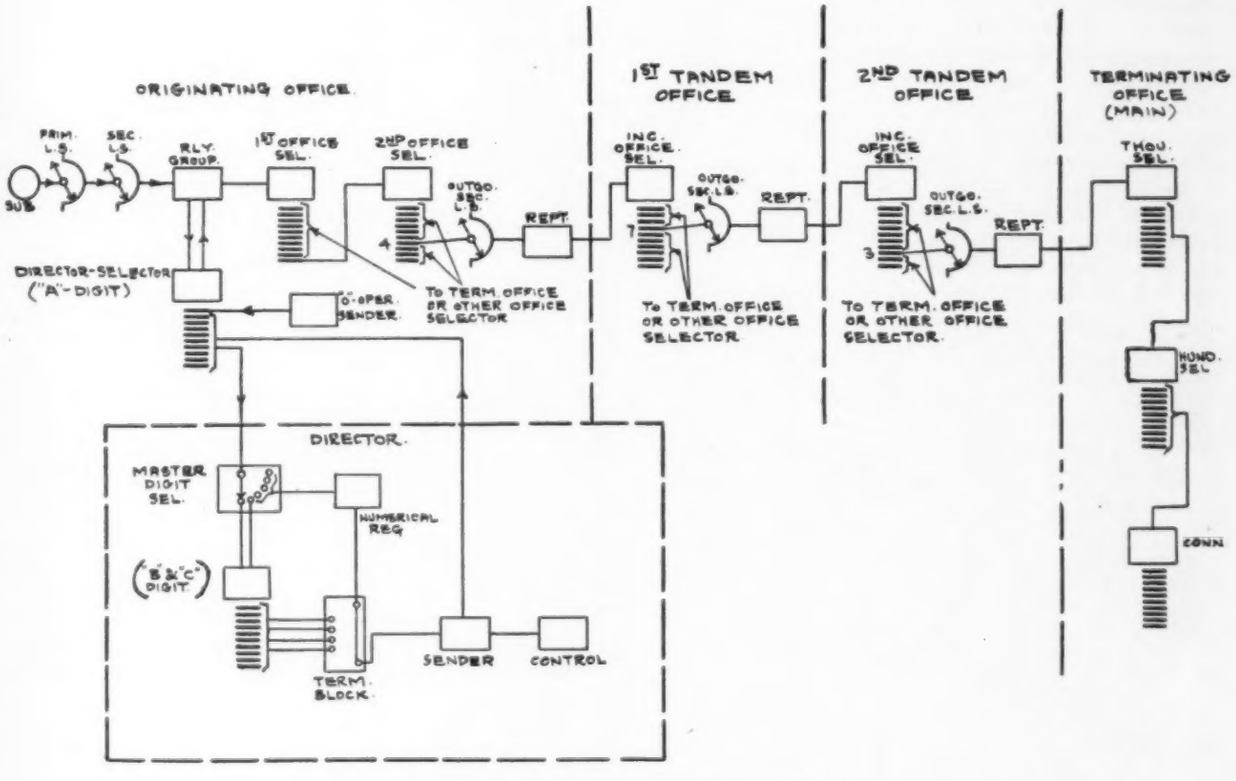

Figure 3. Director Equipped Strowger Metropolitan System

For economic and engineering reasons, the application of automatic operation to large metropolitan areas invariably involves a transition period, which may extend over several years. During this period it is necessary to provide means for handling four general classes of calls, i. e., manual to manual, manual to automatic, automatic to manual, and automatic to automatic.

The Director unit has distinct spheres of usefulness in increasing the flexibility and efficiency of operation in all four of these classes, and it is believed that for the purpose of this article a brief description of its application in the last named class (full automatic) will give an adequate idea of its adaptability.

In large metropolitan areas it seems desirable to identify each subscriber's station by means of an office name and four digits. To dial the desired station, it is the plan to "spell" the first two or three letters of the office name by successive turns of the dial, which "spelling" would be followed by the four significant digits of the called station's designation. It is apparent, therefore, that the dial must be marked with letters in addition to the digits.

Two arrangements of dial lettering are shown in figures 1 and 2. Figure 1 shows an arrangement that has been in use for some little time. With either plan, it takes the subscriber somewhat longer to locate letters than to locate numerals, but there seems to be no such difference in finding time between the two forms of lettering.

So far, the use of the plan in figure 1 has demonstrated that while the spelling scheme is feasible, great care must be exercised in the selection of office names to avoid the possibility of confusion resulting from the subscribers' lack of familiarity with the spelling of any of the office names chosen.

It has also been demonstrated that many subscribers do not differentiate between the letter "I" (corresponding to the numeral 4 in figure 1,) and the numeral "1"; or between the letter "O" (corresponding to the numeral 6 in figure 1) and the numeral "O." This difficulty is accentuated by a practice, common to cities where arrangements are made for automatic numbering, of prefixing O's to the one, two and three digit numbers (all subscribers' numbers must have four digits), and instructing the manual subscribers as follows: "For Monroe 0032, ask the operator for Monroe oh-oh-three-two" instead of "naught-naught-three-two." Under such circumstances it is inconsistent to expect such subscribers, when they use the dial, to differentiate properly.

The arrangement of letters shown in figure 2 overcomes this difficulty. It will be seen that in this case, the subscriber need not differentiate.

In metropolitan areas it is sometimes desirable to retain certain existing office names that have some geographic or historic significance. In order that this may be done without regard to the established trunk routes, it is necessary to dissociate the numbering scheme and the trunking scheme.

This can be accomplished by means of the Director, since arrangements are provided to register the impulses corresponding to the two or three letters of the office name, together with the significant digits of the call number, and to send out other impulses of such number and combination as are required to direct the call, link by link, over the proper trunk routes, to the terminating office; and there to operate the selectors and connectors as required to establish connection with the number dialed.

The Director is attached to the circuit only during the setting up of the connection. When the connection has been established the Director is cut out of the circuit; leaving only the equipment in circuit that is in circuit in standard Strowger exchanges.

The Director equipment can be added to existing two-wire Strowger installations of the later types, any time it may become desirable to dissociate the numbering scheme from the trunking scheme.

As shown in figure 3, a Director-equipped Strowger Metropolitan System consists of primary and secondary line switches; one or more groups of office selectors; thousands selectors, hundreds selectors, and connectors. It will be noted that between the secondary line switch and the first office selector, there is an equipment group containing a director selector switch, which in a three letter office code system responds to the first pull of the dial and selects one of a group of Directors. The second and third pulls of the dial are registered on a switch in the Director.

Suppose the letters dialed are MAI for the office name MAIn. If the arrangement in figure 2 were used, this would have a numerical equivalent of 521. Upon the first pull of the dial, the director selector switch would step to the 5th level, and select a non-busy director on this level. The Director would then register 21 in response to the second and third pulls of the dial. The numerical registers in the director respond to the subsequent pulls of the dial and register the thousands, hundreds, tens and units of the particular call number. An additional register is used in cases where a party line designation is required for "jack per line" party line service.

The relation between the calling office and the called office is determined by a consideration of the trunk routes. A suitable train of office selectors is provided in each office through which the trunk route passes, so that the call may be set up link by link through intermediate or tandem offices. The various links correspond to different selector levels, so that it is easy to see what impulses must be sent to build up the connection link by link from one office to another, and therefore what the relation must be between the letters corresponding to the office code dialed, and the impulses to be sent out by the Director.

The plurality of wipers of the Director digit switch are brought into circuit successively and cause series of impulses to be sent out in a certain sequence, as determined by the cross connections of the several bank contacts. A terminal block is provided in the Director so these cross connections can be altered with a minimum of effort.

For example, suppose to reach the MAIn office it is necessary to set up four links represented by the respective digits 1473. The four contacts of position 21 in the banks of the Director reached from the 5th level of the director selector, would be successively cross connected to points 1-4-7-3 on the terminal block. As soon as the office code has been registered the sender control co-ordinates the first wiper of the Director digit switch with contact 1 in the sender bank and one impulse is transmitted. The sender control then steps to the next position and co-ordinates the second wiper of the Director digit switch with contact 4 in the sender bank, and four impulses are transmitted. The remaining impulses 7 and 3 are successively transmitted in a similar way. The sender control then advances one point and co-ordinates the contacts of respective numerical digit registers, and sends out corresponding impulses.

In case only two links are required to reach the terminating office, say 1-4, the first and second contacts of position 21 would be connected to points 1-4 on the terminal block, and the other contacts of position 21 would be connected to special points on the terminal block and would cause the sender control switch to advance to the position to send the significant digits.

(Continued on Page 38)

How "Wired Wireless" Works

One of the Early Workers in Wired Wireless Describes Multiplex Telephony by Superimposition of Modulated Radio Currents on Wire Lines—Phone Line Broadcasting

By Major J. A. Mauborgne

U. S. Army Signal Corps Engineering Department

Four or five years ago, the average telephone man gave scarcely any consideration to the subject of linking together radio telegraphy and telephony with wire line telephone systems. Multiplexing methods based upon the older arts of telegraphy, by which a multiplicity of telegraph messages were superimposed upon telephone circuits, were about the only combination in practical use, so far as telegraphy was concerned, and, for straight telephony, the use of the phantom circuit afforded practically the only means for securing additional telephone circuit over two physical telephone circuits.

Of course, there were a number of men in the telephone field who were interested in radio as a purely separate means of communication, but these men grew up in the radio world, ordinarily without linking together the wire and the radio circuits, of which they had a working knowledge.

Today we are forced to the conclusion that, henceforth, the telephone engineer must seriously study radio telegraphy and telephony, for "wired wireless" has come to stay, and the telephone engineer must be awakened to the possibilities of this later art, if telephone companies are to take advantage of the opportunities for multiplexing their lines, at a considerable saving of copper; of furnishing additional channels for broadcasting over their lines, and of making a careful study of the situation created by the immense demand for radio antennae, in apartment houses, hotels, and other congested places, which would permit their subscribers to make use of their lines as antennae for the reception of broadcasting, sent not only over their lines proper, but of material broadcast through the ether by radio stations, in the normal way.

Multiplex Telephony with Radio

I shall attempt to confine my remarks, therefore, in the brief time I have at my disposal, to a discussion of "wired wireless" in its simplest form, and to explain and demonstrate, if time and circumstances permit, how multiplex telephony may be accomplished by the superimposition of modulated radio currents on telephone and lighting lines and, also, to dwell for a short time on the possibilities of applying Major General Squier's inventions connected with broadcasting over telephone lines, as well as on the use of such lines as antennae, and on the part to be played by telephone companies in such application.

"Wired wireless" is, perhaps, the best known term and the oldest term applied to the system of multiplex telephony and telegraphy employing high frequency currents on wires. It has been variously called "carrier wave" telephony, "wire radio," line radio," and many other names purporting to give a more or less correct description of what actually takes place when this system is used.

For many years after its discovery by Major General George O. Squier, the present chief signal officer of the army, in 1909, it bore the name "wired wireless," although its inventor at present prefers the title "line radio," as distinguishing it from "space radio" which latter term is sufficiently descriptive to require no further explanation.

"Wired wireless" was first achieved by Major General George O. Squier (then Major Squier) during the years 1909 and 1910. In November, 1910, General Squier filed fundamental patent applications on the "wired wireless" art, on which patents were allowed in the year 1911. In this same year, he published a paper on "Multiplex Telephony and Telegraphy" which marked an epoch in the scientific progress of the telephone and telegraph art.

Many inventors, prior to General Squier's work, had been engaged upon the problem of multiplex telephony and telegraphy, but all of the ideas underlying the schemes which hitherto had been proposed, were based, almost without exception, upon the principles and practices of the old telephone art. The great advance made by General Squier and that which made the use of high frequency (radio) carrier currents successful was the combined utilization of tuned radio circuits and a detector or rectifier at the receiving terminal.

Squier's Method

For this transmitter, he used a high frequency alternator which he coupled by means of a radio circuit, either directly or inductively to a telephone line and, at the receiving end, by means of properly tuned circuits, and, with a detector—first of the crystal type and, then, in 1910, of the audion or valve type—he first demonstrated the practicability of transmitting speech over a wire without that speech being heard by the ordinary telephone instruments attached to the same wire. By this achievement, the common principles of the radio art were immediately made available to the older wire systems and a new method of transmission of intelligence was created.

Upon the announcement of the invention, a number of engineers attacked his proposal and maintained, after mathematical analysis, that the attenuation of the high frequency currents on the wires would make the scheme impracticable for multiplex telephony. It is to be noted, however, that the comments of the engineers mentioned were made in the days when modern radio amplifiers did not exist. It is to be noted, also, that these same engineers proceeded at once to experiment with the proposed system.

The modern amplifier makes possible the reception of extremely small amounts of energy and the magnification of the sounds produced thereby, so as to give strong signals. The high frequency alternator used by General Squier was, at the time of his invention, in the experimental stage, and did not appear to afford a practicable solution as a source of energy for commercial multiplex telephony. It was not until the arrival of the three-electrode vacuum tube as a generator of high frequency current that real progress was made toward the practical realization of the scheme. The practical development of the new art of utilizing

low-frequency carrier currents and the solution of the actual problems of making a practical multiplex telephone circuit have now been carried to an advanced and commercial stage, and long distance telephone and telegraph lines employing the system are in daily operation between a number of large cities.

Developing Practical System

In this country, great honor is due to the research staffs of the Western Electric Co. and the American Telephone & Telegraph Co. and, particularly, to E. H. Colpitts and C. B. Blackwell, for the development of a practicable system. That this country is not alone in the development of this new art is evidenced by the publications of Wagner, Faszbender and Habann, in Germany, and of Marumbo in Japan. The first two papers mentioned contain interesting accounts of the development of wired radio apparatus in Germany during the war; the latter paper, though quite brief, is also of great interest, as it contains descriptions of methods and appartus used where a high voltage power line was employed for tranmission means.

A very excellent contribution to the literature on the subject of "wired wireless" is to be found in the paper by E. H. Colpitts and C. B. Blackwell, which is recommended to those who are seriously inclined toward the study of "wired wireless." This paper very well outlines the method of carrier current telephony used by the Bell companies today.

In the Signal Corps of the army, very little was done toward the development of "line radio" or "wired wireless" for some time before and during the recent war, but, since that time, a number of papers have appeared in the scientific press, recording the achievements of various Signal Corps engineers, particularly R. D. Duncan, Jr. References are made in the foot notes to this paper to all the articles mentioned herein.

The original idea conceived by General Squier, in 1909, was simple enough: The ether waves set up by the transmitter were simply guided by the wires. Tuned circuits for reception and transmission were employed, as stated, and so various channels, each employing different wave lengths, could be received, each on its own tuned circuit. Two of General Squier's original diagrams, contained in his paper of 1911, are reproduced and show that his fundamental idea is really the basis of even the more highly engineered schemes of carrier current telephony at present in practical use.

Radio Applied to Local Battery Line

In Fig. 1, we see the application of the principle of superimposing a radio frequency transmitter and receiver on a standard local battery telephone line, in which case the radio apparatus was tied to one of the lines forming the telephone pair, the other side of the radio apparatus in each case being grounded. Fig. 2 shows a similar arrangement except that both the radio transmitter and receiver are bridged across the two lines instead of being grounded as in Fig. 1.

In both diagrams, there is shown this fundamental essential—that there shall be placed on the line an oscillating high-frequency current known as the "carrier," supplied, in the particular case mentioned, by the high-frequency alternator **G** tied to a tuned circuit including a microphone, which, in Fig. 1, was placed in series with the high-frequency generator and the tuning elements—**C′** variable condenser, and **P**, an inductance. Coupled with this was another tunable circuit consisting of a variable air condenser, **C**, loading inductance, **L**, and inductance **S** or secondary inductance, in coupling relation to the primary inductance, **P**. This inductance, **S**, had its lower end grounded.

The generator circuit **G**, condenser **C′**, and inductance **P**, having been tuned to a frequency within the frequency range of the high-frequency generator, was coupled to the secondary circuit, **C**, **L**, **S** and **P**, which was connected to the telephone line over which the high-frequency current was to be sent. The ammeter, **A**, indicated when the secondary and primary circuits were in tune, resonance between these two circuits being indicated by the maximum reading of the needle.

The primary or generator circuit in this case was modulated by microphone **M**, in this way varying the steady current set up on the line by generator **G**. So there were set up the two desirable features for the production of modulated high-frequency carrier waves capable of translation into audible speech.

Telephony is accomplished by altering the amplitude of the high-frequency wave in accordance with the speech wave, at the transmitting end, and, at the receiving end, the wave is rectified by some type of detector, so that its varying amplitude is reproduced as a speech wave. If very high carrier frequencies are employed, one distinct advantage which results from their use is the elimination of the speech distortion so common to long distance wire telephony.

In accordance with radio telephonic theory, three frequencies will be present in the telephone line if the modulating frequency contains no harmonics—respectively, the main carrier frequency and the sum and difference of the main carrier frequency and the modulating frequency. If harmonics are present in the modulating frequency, then, in addition to the three main frequencies, there will be additional frequencies corresponding to the sums and differences of the main frequency and each of the harmonics.

Assuming that the fundamental frequency of the voice is 800 cycles per second and the limiting harmonic is 2,000 cycles per second, it is readily seen that, at a high carrier frequency, the band of frequencies which is transmitted is so small a percentage of the main carrier frequency, that the attenuation to all frequencies within the band is practically the same. The elimination of speech distortion, due to this cause, thus automatically results. On the contrary, if we employ a carrier wave with a frequency of 10,000,

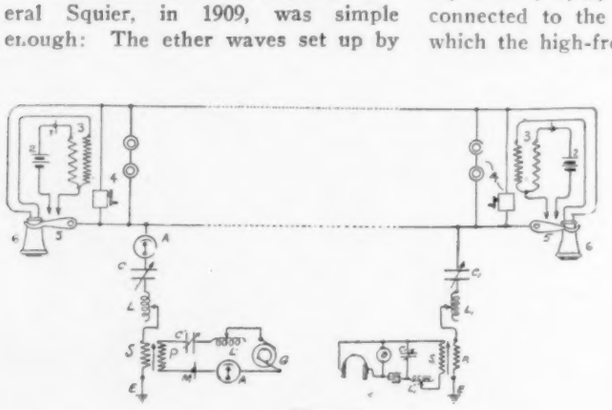

Figure 1

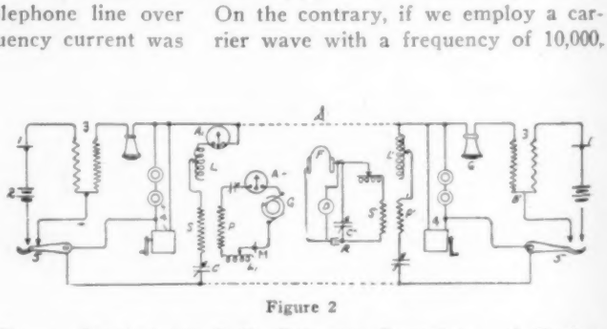

Figure 2

Fig. 1. Superimposing Radio Frequency Transmitter and Receiver on Standard Local Battery Telephone Circuit.

Fig. 2. Radio Frequency Transmitter and Receiver Superimposed on Standard Local Battery Line with Receiver and Transmitter Bridged Across Line.

we shall have all frequencies from 8,000 to 12,000, and the tuning of the transmitter, if sharp, will cause very unequal treatment and consequent distortion of the speech at the receiving end.

Hence, sharp tuning with long carrier waves or low frequencies is impracticable and recourse has to be made to "filters," to separate the various channels when, for extremely long distances, we employ the lower frequencies to avoid very high attenuation. In actual practice, the frequencies employed in multiplex telephony over the long lines are of the order of 10,000, 15,000, 20,000 and 25,000 cycles and, with such low frequencies or long wave lengths, elaborate "filter" circuits, such as those devised by J. A. Campbell of the Western Electric Co. or K. W. Wagner, of Germany, must be used.

Unless the distances to be covered are such that extremely long wave lengths or low frequencies must be used, the necessity for the filter circuits disappears and we are free to resort to the original system using short waves according to General Squier's original method. We shall now direct our attention to some modern circuits employed by the Signal Corps, in which short waves are employed to cover considerable distances, and in which no "filter" circuits are employed.

In the early part of 1919, experiments were conducted by the Signal Corps on a wire belonging to the Postal Telegraph Co., running between Washington and Baltimore, a distance of 66 wire miles. The line was aerial throughout the distance of transmission, and contained a single section of overhead cable approximately ¼th of a mile in length. In the experiments, the transmitting and receiving apparatus was connected between the line and the ground. The circuit diagram is shown in Fig. 3. The carrier frequency employed was 600,000 cycles per second, corresponding to 500 meters in wave length.

Throughout the entire tests, the telegraph line was in ordinary duplex telegraph operation. No interference from the ordinary telegraph operation or from the "wired wireless" was experienced by either system. The normal range of the apparatus, known to the Signal Corps as radio telephone, set, SCR-67-A, when functioning as a radio telephone, on an ordinary antennae, in communication with similar apparatus, is ten miles; hence, it is seen that by means of wired radio, the range of communication with the same transmitter was increased many times.

For telegraph purposes only, a vacuum tube was employed for operation from a 220-volt, direct-current lighting source. A diagram of the apparatus is shown in Fig. 4.

Results of these preliminary experiments were of unusual interest, as it was demonstrated that transmission over relatively great distances could be accomplished with frequencies greatly in excess of the value which had heretofore positively been considered as the upper limit. It is to be noted that, in adjustment of both the transmitting and receiving apparatus, the lines were tuned to resonance by means of a series line capacity. The tuning, while not as sharp as that obtained with a radio antenna, revealed a distinct resonance point and could be made broad or sharp at will by altering the magnitude of the loading or coupling inductance.

Later experiments conducted by the Signal Corps, over the lines of the New York Central Railroad, commenced in the latter part of 1919, developed many other valuable features which have been recorded in the paper by R. D. Duncan, Jr., "Recent Attainments in Wired Radio," referred to in the foot notes to this paper. In this case, telephonic and telegraphic communication was established over a pair of wires from Elmsford, N. Y., just north of New York City, to Albany, N. Y., a distance of 130 miles.

A good quality of speech and both continuous wave and buzzer modulated telegraph signals were obtained. The carrier frequency varied from 600,000 to 300,000 cycles per second (wave length 500 to 1,000 meters). The high-frequency power output varied from less than ½ watt to 20 watts, depending upon the apparatus used. The receiver employed a detector and two stages of audio frequency amplification.

Standing Waves Present

In the Washington-Baltimore experiments, as well as in the later experiments of the Signal Corps, evidence of the existence of standing waves on the telephone lines was obtained. Standing waves, as is well known, are produced by reflection from either the far end of the line or from intermediate points where there occurs a sudden transition in the electrical properties such as produced by the introduction of short lengths of cable or changes in the size of the conductor.

In the latter case, unless the reflection is complete, a portion only of the outgoing wave will be turned back and a portion will proceed unreflected. As a result, there will occur partial reflected and partial unreflected transmission.

The location of the receiving apparatus with respect to the transmitter, when standing waves are present, is, therefore, determined largely by the wave length or frequency of the carrier wave, since, for efficient reception it is necessary to avoid both voltage and current nodes. It was found that altering the frequency at the generator terminal apparently did not produce an effect in moving the nodes and loops along the lines equivalent to that of moving the receiving apparatus.

In the preliminary experiments previously mentioned and in the earlier New York Central tests, one overhead wire with a ground return was employed. A comparison of this arrangement with an all-metallic circuit showed that the latter was the much superior of the two, both as to volume of speech received and the elimination of external disturbances such as that produced by nearby radio stations. The reason for this improvement is attributable to the pronounced energy-radiating and absorbing properties possessed by the one elevated wire with ground return.

The question of cross-talk was investigated, as it was believed that at

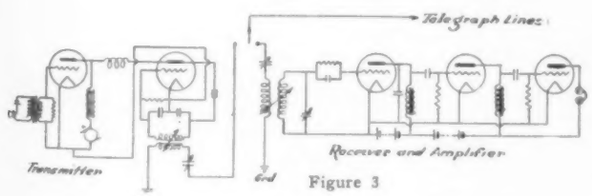

Figure 3

Fig. 3. Experimental Circuit Used in Line Radio Over Washington-Baltimore Telegraph Line.

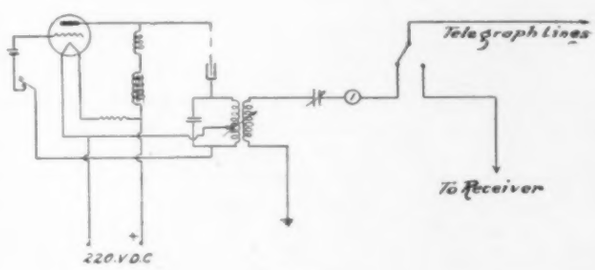

Figure 4

Fig. 4. Line Radio Experimental Circuit for Telegraphy. Vacuum Tube Operated from 220 volt Direct Current Lighting Circuit is Employed.

the high frequencies, inter-line disturbances might be prohibitive of utilizing the same carrier frequency on more than one line or pair of lines on the same pole. In the Washington-Baltimore tests, it was found that it was possible to receive signals with the lead wire to the receiving apparatus disconnected from the line in question and held in the immediate vicinity of the same or wrapped around, but not making contact therewith. Signals of reduced intensity, also, were received with a lead wire connected to other immediately adjacent lines on the same cross arm.

Complete elimination of cross-talk to other lines, however, was obtained when the first few miles of conductor adjacent to the transmitting apparatus ran through underground cable. When employing an entire metallic circuit, at the very highest frequencies used, there was a complete absence of cross-talk to the other conductor pairs on the same pole.

The problem of multiplexing the lines has been given some study by the Signal Corps, but no definite data is available for presentation at this time. The construction of the various carrier frequencies to be used in multiplexing is roughly determined by the condition that each band of wave lengths needed for transmission shall be 5,000 cycles in width and that these bands shall not overlap; but the problem is more complicated than this mere statement would imply, since the matter of harmonics and other points also, must be considered in the selection of waves for multiplex working.

Two Way Wired Wireless

It is evident that for successful operation, wired wireless telephone systems must be capable of being worked in either direction without switching. This is made possible by using a different carrier frequency in each direction or by using the same frequency and a bridge arrangement. The latter is a much more difficult method, but allows of more channels. A discussion of this arrangement cannot be entered into at this time, but can be found in the bibliography of the art referred to.

Filters

Referring again to the subject of "filters," about which much has been written, we will state briefly that the "filter" is arranged to pass a band of frequencies of a certain width. Usually this band of frequencies is 2,000 per second wide, and the "filter" must pass this band with a very small attenuation and offer a large attenuation to all frequencies outside this range. Fig. 5 shows a "filter" chain consisting of inductances and capacities, designed by Campbell, which will pass low frequency currents, and Fig. 6 one which will pass high frequency currents. Two such chains in series will give the required characteristic shown in Fig. 7.

Another arrangement, Fig. 8, is due to K. W. Wagner, which gives a curve similar to that shown in Fig. 7, and the band can be made of the correct width and for the actual frequencies desired by a suitable choice of the inductances and capacities. Still another

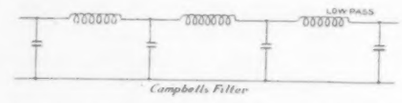

Fig. 5. Filter Chain That Passes Low Frequency Currents.

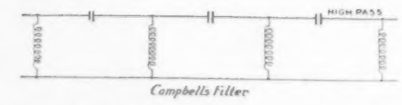

Fig. 6. Filter Chain That Passes High Frequency Currents.

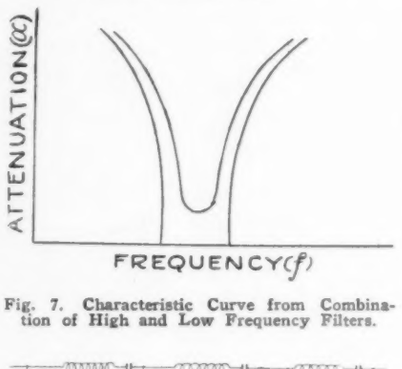

Fig. 7. Characteristic Curve from Combination of High and Low Frequency Filters.

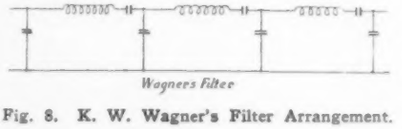

Fig. 8. K. W. Wagner's Filter Arrangement.

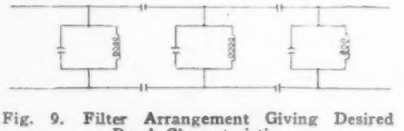

Fig. 9. Filter Arrangement Giving Desired Band Characteristic.

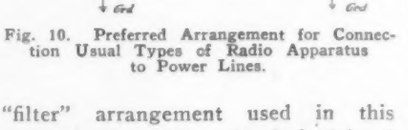

Fig. 10. Preferred Arrangement for Connection Usual Types of Radio Apparatus to Power Lines.

"filter" arrangement used in this country, also, giving the desired band characteristic is shown in Fig. 9.

For a very complete exposition of the theory of these "filters," it is recommended that K. W. Wagner's article in the "Archiv fur Electrotecnick" Volume 3, 1915, be consulted.

Much might be said about the harmonic generator and balancing network arrangements employed by the American Telephone & Telegraph Co. in this country, but time will not permit of the introduction of this matter. A careful study of this can be made by those interested by consulting the paper of Colpitts and Blackwell before referred to. Likewise arrangements for transmission of wired wireless over high-tension power lines cannot be dwelt upon here, but must be found in the literature on the subject. It is believed, however, that a brief reference to the method of wired wireless broadcasting over power and light lines may well be touched upon at this time.

Some time during the months of March and April of the present year, Major General Squier made an announcement of the work which had been done in the office of the Chief Signal Officer in connection with the subject of broadcasting on light lines, upon which General Squier has applied for patents in connection with his earlier patents on the broad general subject of wired wireless.

These experiments have demonstrated that it is entirely feasible and practical to transmit high-frequency current telephony over power lines and electric light circuits, and to receive it at any point on the line. A single transmitter with an output of not over 50 watts connected to the power or lighting lines of a city at some suitable point may broadcast over a considerable area and may be received by a great number of people by connecting ordinary radio receivers at various points on the line, the connection usually being made by a suitable plug placed in any lamp socket.

Short Circuit Danger Avoided

The transmitters and receivers are of usual types now employed for radio telephony and may be connected to the power line in various ways; the preferred arrangement being used at present is shown in Fig. 10.

In this method of connection, the danger of short-circuiting the mains is entirely avoided—the condenser between the mains acting as a by-pass for the high-frequency currents only, but allowing the low-frequency power current to flow along the mains. For the radio currents the two mains are connected in parallel and used as one conductor, the ground being the return conductor.

It is to be noted, however, as before mentioned, that there is a tendency for the lines in this case to radiate because of the relation of the line to the ground. Hence material broadcast on

electric light lines in this way, particularly if the lines pass out from underground conduit and become overhead wires, may be received by any ordinary antenna entirely disconnected from the lighting circuit.

Better results with practically no radiation from the lines are obtained by connecting the transmitters and receivers between the mains instead of to ground, the mains being suitably protected by condensers to keep the large power current from passing through the radio apparatus. In addition to the condensers shown in Fig. 10, the receiving set itself should have a variable air condenser in series with the tuning inductance of the primary circuit for the purpose of tuning the line.

A number of plugs to screw into the electric light socket, including in their structure condensers suitable for connecting to the light lines, are now on the market, and the one known as the "Super-Antenna" designed by Radio Engineer Duncan of the Signal Corps, is found to meet all requirements, giving both suitable protection and satisfactory results.

The use of the line radio method of broadcasting as compared with space radio broadcasting has many advantages. In the first place, the ether channels used for space radio broadcasting are limited, and even the few wave channels which are available for broadcasting can be more profitably employed for such radio activities where space radio is the only or best method of communication. By space radio is meant ordinary radio telephone transmission. Also, since there is practically no radio interference caused by broadcasting on power lines or light lines, any number of wave channels may be employed, thereby multiplying the number of stations which can be operated on the same line.

It is conceivable that in every community we may have several transmitting stations, operating at the same time but each on a different wave length and supplying different services. One may be used exclusively for music, another for current news, and still another for educational information. Obviously, by this means of broadcasting, no antenna is required for reception. In order that the radio broadcasting by the foregoing method may be received, a suitable plug connection in the electric light socket is all that is necessary wherever the lighting circuit exists.

Results of Experiments

During the recent experiments of the Signal Corps in connection with this wired wireless broadcasting over electric lighting lines, carried on during the month of May of the present year by a Signal Corps engineer in cooperation with the North American Co. and the Cleveland Electric Illuminating Co., a very successful wired wireless broadcasting was accomplished over the lines of the latter company, in Lakewood, on the outskirts of Cleveland. A very complete account of the results obtained, together with the descriptions and diagrams of the apparatus used, can be found in the article of R. D. Duncan, Jr., "Wired Wireless Broadcasting," Electrical World, Volume 80, No. 8, Page 367, for August 19, 1922.

The conclusions drawn from the Washington and Cleveland experiments are that from a technical standpoint, wired wireless broadcasting over electric power lines is entirely feasible and that with the proper choice of wave lengths, the radiation from the lines may be reduced to such an extent that it will not interefere with radio communication.

Apart from the subject of actually broadcasting material over the power lines themselves, attention is invited to the fact that these lines, if connection thereto be made by the condenser plug mentioned, offer a very fine means for receiving from ordinary broadcasting stations, thereby, of course, doing away with the ordinary antenna.

Similarly, a matter which is of considerable interest to the telephone companies, is that telephone lines can be used both for wired wireless broadcasting after the manner described for light lines and with practically identical connections, as well as for the reception of signals from ordinary broadcasting stations, the lines in this case being simply used as antennae. This, of course, raises the question as to the right of telephone companies to charge for and control any and all additions or connections to their wires, which are really the property of the individual companies and not public property.

Telephone contracts should be redrawn at once in such a shape, for the protection of the companies, that no piece of radio apparatus, transmitter or receiver, shall be connected to any telephone line without license from the telephone company, and then only with such connecting devices as shall have been approved and sold by the telephone company concerned. These ordinary precautions, and the sale to individuals of suitable devices for connecting to telephone lines with a numbered license, issued in every case, should give the telephone companies an additional income for the use of their lines in connection with the reception of matter broadcast either in the ordinary way or over the lines.

It is suggested that, until further experiments are carried out by radio engineers, in connection with the telephone lines, no transmitter be licensed to broadcast over any telephone line, because of the confusion which may occur and possible damage to terminal and switchboard apparatus, if proper precautions are not taken.

Suggests Quick Investigation

In conclusion, I wish to state that it is my belief that telephone companies should investigate this wired wireless proposition very carefully and without delay, not only because of its possibilities for multiplex telephony, but also for the last two features mentioned, namely, the use of telephone lines for broadcasting by wired wireless, and the use of such lines as antennae for ordinary reception. I regret that more time could not be given to an exposition of this important subject, but I feel that it is one which must be carefully studied and that much experimental work must be done in connection therewith by those interested, before a clear understanding of the subject can be reached.

I have added below a brief bibliography which should be of assistance to the telephone engineer in giving a working knowledge of the art up to date. The list includes all the papers referred to in the body of this paper.

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OPINIONS AND COMMENTS

SOME VIEWS OF TELEPHONE REGULATION

An extraordinary amount of interest is attached to the recent meeting of the National Association of Railway and Utilities Commissioners held in Detroit during the latter part of November. The special importance of the meeting to telephone men lies in the discussion of telephone regulation that occurred. It is unusual to have such an authoritative presentation of three different viewpoints of this subject from the same platform. Mr. Thayer is the highest authority on matters of policy of the Bell system and there is no man in the Independent group better qualified to express opinions of that group than is President MacKinnon of the National Independent Association. Commissioner Reed of Kansas, it may be assumed, represents fairly the attitude of the regulatory bodies since he presents not only opinions of his own Commission, but opinions from other Commissions as well.

The future development of the telephone industry as a regulated public utility depends not only on the policies of the telephone management, but upon the attitude of the public regulatory bodies as well. Mr. Thayer and Mr. MacKinnon presented the views of the two groups of the telephone business in the matter of public regulation and its effect upon the development of the business. Commissioner Reed, speaking from the viewpoint of a member of a utilities commission, indicated some of the difficulties of control and some of the dangers that might arise from the present organization of the telephone field.

In several matters all of the speakers were in accord. All agreed that competition in the telephone field when it means service by two companies in the same locality is an economic waste and results in partial rather than complete service. Both Mr. Thayer and Mr. MacKinnon spoke of the desirability of the continuation of two groups in the field and Mr. Reed indicated the same thing when he expressed the fear that a stage would soon be reached when there were no longer separate companies operating in the same section and the same state.

Mr. Thayer emphasized the Bell ideal of a national service and the duty of maintaining it, a duty which rests alike on each of the three groups represented at the meeting. The Bell management must think in big figures in labor, in material and in finances or it will be overwhelmed by public demand. The results of the past have justified the policies of the Bell companies and he is of the opinion that the public is willing and able to pay the cost of the service that it has been getting.

Both Mr. MacKinnon and Mr. Reed refer to the higher cost of operation of the Bell companies over the cost of operation of independent companies, but from rather different standpoints. Mr. MacKinnon recognizes the economic fact that, in the telephone business, a large unit cannot be operated at the same cost per subscriber as a smaller unit and argues that independent companies are being penalized for their more economical operation by being required to accept the same rate of return on its investment that the Bell receives. The burden of his argument is that the independent company that can operate at lower rates than the Bell is entitled to compensation in the form of a higher rate of return.

Mr. Reed does not refer to the high cost of operating large units, but attributes the higher cost of Bell operation, in part at least, to what he considers to be a refusal to take advantage of opportunities to economize in operating its properties. He frankly regards the Bell system as a monopoly of the telephone business and charges it with having a higher investment, higher operating costs and higher rates than are necessary for the provision of adequate telephone service.

Each of the three speakers looks upon the organization which he represents as being charged with the performance of the same duty, namely, the providing of adequate telephone service to the public at a reasonable cost. It is to be expected that there would be differences of opinion as to the manner in which this duty should be performed. A first reading of the opinions might seem to indicate that there exists an irreconcilable difference of opinion particularly between the Bell group and the Utilities Commissioners as represented by Mr. Reed. That the difference is not as great as it might appear is shown by the figures quoted by Mr. Thayer that out of 204 cases in which associated Bell Companies have been involved before regulatory bodies since the termination of Government control in all but 20 cases have the companies accepted the decisions rendered.

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In spite of the differences of opinion expressed, there can be no doubt but that the Utilities Commissioners assembled at Detroit gained a new view of the problem of regulation of telephone utilities from the papers by the telephone men. Likewise the telephone men who assembled to hear the papers obtained a new view of the problem of the Utilities Commission. The first step toward a complete understanding between the various parties at interest is a frank statement of position by those who can speak with authority. The clear, straightforward statements at the Detroit meeting should do much to promote better relationship between telephone companies and regulatory bodies in the future.

A NEW DEPRECIATION THEORY

In its order in the Northwestern Bell rate cases handed down on November 4, the Nebraska State Railway Commission advances what seems to be a new theory of the depreciation reserve. Briefly the Commission's idea seems to be that the depreciation reserve is for the purpose of maintaining the property in a good operating condition rather than to maintain the integrity of the investment.

In the view of the Company this amounts to confiscation of a portion of the investment. Fortunately the Company has not accepted the decision and the matter has been taken to the Federal Courts where in due time the soundness of the Commission's theory will be tested.

COMPIMENTS OF THE SEASON

Before another issue of TELEPHONE ENGINEER reaches its readers those joyous holidays on which are celebrated the Nativity of Christ and the coming of the New Year will have passed. We take occasion, therefore, at this time to wish to all of our readers a very happy Christmas and health and prosperity during all of the New Year.

THE YEAR'S END

With December here, we are approaching the end of another year. As we look back over it, the 1922 has been a significant year in the telephone industry. Construction operations exceeding in magnitude those of any single year have been undertaken and are now practically completed. Financial operations conducted on a larger scale than ever before have brought new capital into the business and thousands of new stockholders into the ranks of telephone security holders.

Truly a wonderful business is this telephone industry. Years ago we thought we were reaching the saturation point and yet the last year has brought demands for new plant and for additional service greater than we have ever experienced. It is a growing business, the public demands and appreciates its service, its investors are assured not of a large but of a steady return, its employees are well paid and satisfied. Everyone associated with it, from the humblest employe to the highest official may be proud of his connection with it and of his part in making 1922 a notable year in the industry. With 1922 in retrospect we can look forward with confidence to 1923 and succeeding years.

ABANDON GOVERNMENT OWNERSHIP IN ITALY

Advocates of government ownership and operation of public utilities have been accustomed to quote the results of government ownership in Europe to support their arguments. It must be rather disconcerting to these people to find their arguments disappearing as news comes through concerning the straits in which the European government services find themselves.

Recently we have had reports that private capital is to be enlisted to resuscitate the moribund telephone service in France. Still more recently, news dispatches have carried the program of reform which Benito Mussolini, the new Premier and practical dictator of Italy, is proposing. Of the four principal reform measures one is the immediate sale of local telephone plants to local capital. This is to be followed by the sale or lease of the railways to private interests.

Faced by the problem of rehabilitating the State credit, the new Premier proposes to eliminate the causes of the steadily mounting deficit. Losses in the operation of the government telephones and railways have contributed largely to the financial difficulties of the Italian government and the services have apparently suffered through inefficiency and official incompetence. By turning the telephones and railways over to private interests the National Treasury will be relieved of the burden and private initiative and enterprise will be given the opportunity to make the needed economies and improvements.

Fortunately for the public and for the telephone industry in this country, there has been little sentiment in favor of government ownership since the experiment in Government operation during the war and the recent experiences in France and Italy will tend to retard the growth of such sentiment in the future.

Certainly, no one could wish to substitute governmental bureaucracy or political control for our present active, energetic management of privately owned telephone companies.

AN INDEX FOR TELEPHONE ENGINEER

An index of all the more important articles that have appeared in Telephone Engineer during the past year is in preparation and will be included with the January number. This will be a convenience for many of our subscribers who wish to retain and bind their copies as it will provide an easy means of locating many of the articles which are of permanent value.

CHICAGO MONARCH'S NEW HOME

Prominent Independent Company to Complete Move by First of Year

Chicago, Ill.—By the first of the year the Monarch Telephone Mfg. Co. will be back in Chicago, the birthplace of the organization, which it left in January, 1912 when Fort Dodge, Iowa capital became interested in Monarch operations.

According to the company's statement the principal reasons for the return to Chicago are "the desire to more efficiently handle our growing business—manufacturing and jobbing—and to more satisfactorily serve all of our customers who are scattered over a large part of the United States and foreign countries."

The west side factory district of Chicago will be the Monarch's new location. A large warehouse will provide quick shipping facilities. Monarch's executive personnel will remain unchanged, and most of the factory force will make the move to Chicago also.

The Monarch company has been registering a substantial growth that took on a new burst of speed when the Gary interests invested a considerable amount and acquired control in 1920. Headed by L. Q. Trumbull as General Manager, the Monarch personnel now comprises an engineering, factory and sales staff that fully justifies the ambitious and confident expansion plans that have been responsible for the transfer to Chicago.

No dissatisfaction with Fort Dodge is to be inferred by the Monarch withdrawal, says H. L. Harris, Monarch's Vice President. Mr. Harris stated that there are two telephone manufacturing centers of the world, Chicago and Liverpool, and that Monarch should be in one of them.

Each detail of the Monarch move has been so carefully worked out that the actual transfer of equipment and force is being accomplished without facturing schedule.

Increased facilities for manufacturing and jobbing business have allowed plenty of elbow room for the speedy erection and operation of Monarch's manufacturing equipment and arrangement of stock.

Until further notice the Monarch Telephone Mfg. Co. requests that all communications be addressed to the Fort Dodge office.

New York City—Roller-Smith Co. has issued a Bulletin 20, descriptive of its radio telephone receivers and loud-speakers.

UP-STATE NEW YORK MEETS

Good Attendance At Active Session of Sixth New York District.

Middletown, N. Y.—An attendance of more than a hundred took part in the November meeting of the Sixth District of the Up-State Telephone Assn. of New York.

A. C. Madden, secretary of the Chamber of Commerce of Middletown, welcomed the telephone men to the city and commended the organization. He pointed out how necessary it is in the day of "political self-seekers" that they work unitedly to protect their own interests.

George R. Fuller, of Rochester, president of the association, responded to Mr. Madden's talk. J. G. Ihmsen, of Albany, vice-president and general manager of the Up-State organization, presented some figures indicating its growth. Mr. Ihmsen advocated co-operation between telephone companies and subscribers, and he also advised close co-operation with the municipal and state authorities and with other public utilities with a view to bringing about a condition of harmony throughout the state. He cautioned all telephone companies to improve their service wherever it is possible to do so.

MISSOURI RENEWS MEETS

Big Attendance and Lively Program Mark Convention Revival.

Jefferson City, Mo.—After a rest of a year the Missouri Telephone Assn. renewed its convention schedule with a brisk and business-like meeting at the Madison Hotel, Jefferson City.

Governor Arthur M. Hyde of Missouri addressed the opening session, paying tribute to the telephone and to telephone men for the parts played in the remarkable industrial and community progress of the last few decades. John B. Maling of Chicago repeated his address on "the Origin and Effect of Class and Freak Legislation" which was so well received at the Independent convention in Chicago.

W. S. Vivian, the busy apostle of better public relations, cut loose with a peppery presentation of methods of attaining public good will. Tales of unswerving fidelity to the public interest, so frequent in the telephone industry, should be broadcast, said Mr. Vivian. The absorbing human interest story of the telephone's development, the high standards of the operating companies, and the telephone's work in raising the standards of community life, also afforded opportunities for making the public realize the value of the telephone, which should be pushed to the utmost, according to this expert's remarks.

One of the features of the convention which tied up with the tenor of the Vivian address was the demonstration of the telephone loud speaker and repeater made at the state capitol Wednesday evening.

A bright and well founded promise of co-operation from the state highway commission in the many matters wherein the interests of the wire companies and the highway commission are united, came in the address of B. H. Piepmeier, Chief Engineer of the Missouri State Highway Commission. Mr. Piepmeier's talk on the "relations between the State Highway Commission and the Wire Using Companies in Missouri" outlined the method of keeping contact between the interested factors through utilization of the office of the telephone association's secretary.

Charles C. Deering, Secretary-Treasurer of the United States Independent Telephone Assn., made a brief talk on association value to the operating companies and called for the support of the national and state associations by the operating units.

W. O. Pennell, Chief Engineer, Southwestern Bell Telephone Co., addressed the meeting on "Increasing Cost of Telephone Plant." His talk was illustrated with charts showing the trend of costs based on appraisals of typical plant, and exhibiting the proportion of fixed charges in a telephone company's expenses. His analysis of cost of plant, and the factors which influence it, and suggestions for lowering the cost of construction, made one of the features of the meeting.

The concluding session was devoted to an open forum in which J. G. Crane, L. M. Kraege, G. W. Schweer, R. W. Herrick, and A. M. Benedict spoke.

Pioneers Meet

Shields Smith of Sedalia was inducted into the Independent Pioneer's organization following a bitter debate, during which his virtues and vices were brought to light after the fashion of the merrymaking Pioneers. Smith's admission to the ranks marked another triumph for the dark horses. Miss Gladys Morrison of Moberly supplied entertainment for the eyes and ears of the assembled old timers with several delightful vocal solos. Frank Eldridge, John Wopat, and W. S. Vivian also added to the gaiety of nations by their musical performances.

Exhibitors at the convention expressed general satisfaction with the business drummed up and the prospects for 1923.

"N. S. F."? ON THE Q. T., P. D. Q.

How Big Bank Uses Kellogg for Quick, Confidential Service

Dayton, Ohio.—One of this city's large financial institutions recently added a private telephone system to its already very efficient methods of banking. This system not only forms an important part of its protective system, but in addition acts as a retainer of its client's business.

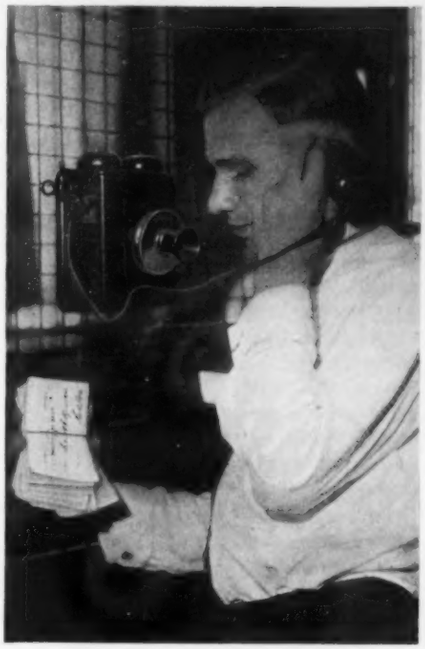
When a check is presented for payment there sometimes enters a disagreeable element; that of ascertaining the bank balance of the party who has drawn the check. To do this the bank teller must get in touch with the bookkeeping department. In a large bank there are many people constantly waiting at the "Paying Teller's" window and the persons presenting checks are many times caused a degree of embarrassment by the teller using a phone adjacent to the window. The inquiry regarding the validity of the check is generally overheard by several people waiting next in line and it creates a certain resentment in the customer which is centered on the bank, the teller, and humanity in general.

To eliminate this, a combination common battery telephone and push button system was installed by the Kellogg Company consisting of a No. 8-B desk type P. B. X., standard common battery wall and desk telephone and modern ringing equipment. The system is operated in the following manner: When a check is presented and there is a question in the teller's or cashier's mind as to its payment, he pushes a button (which is connected to the condenser of ringer circuit of the telephone), located beneath his desk, a certain number of times. The attention of the operator is attracted and in response to that certain signal, rings the telephone located in the rear of his cage. He then excuses himself, taking a mental note of the name and amount of the check and proceeds to get the desired information without being overheard.

This system enables the bank to protect itself and at the same time causes its clients no mental discomfort, thereby holding their good will and their business.

Vermont Plant District Meets in January and February

Montpelier, Vt.—At a meeting of the Telephone Assn. of Vermont, recently held here it was decided to divide the state into five districts and to hold meetings in each during January and February, 1923.



Teller's End of Kellogg System that Rushes Confidential Information.

PENN PLANNING

Association Asks Advice in Making Coming Meeting of Great Value

Harrisburg, Pa.—In recent bulletins the Pennsylvania State Telephone and Traffic Assn. says: "The Annual Convention of the Pennsylvania State Telephone and Traffic Assn., will be held in the Penn-Harris Hotel, Harrisburg, Penn., on Thursday, Friday and Saturday, January 11th, 12th and 13th, 1923.

"It is our desire to make this coming convention, one of interest to all, and in order to be able to do so, we must know what subjects you most desire to hear discussed. We, therefore, urge upon you the necessity of writing us fully as to your wishes in this matter, setting forth those subjects which are of most interest to your company, and any other thoughts or ideas which you may have in regard to the conduct of the meetings to be held.

"All of the manufacturers who exhibited last year, will again be on hand and several others requested space for additional exhibits.

"Gus" Lane, Arkansas Chief, Gets Hearty Boost

Little Rock, Ark.—S. A. Lane, Division Superintendent of the Southwestern Bell, and newly elected head of the Arkanesas Utilities Association, stands high in his community, as the following editorial from the Little Rock News attests. In its comment the News states Lane's election to the presidency of the association "was deserved recognition of a most capable man. It adds: 'Gus' Lane is not only a "good fellow" (and he is that), but he is a thorough-going business man, with modern ideas, a man who believes in taking the public into his confidence, and who looks upon a public utility as a public servant and not a public master. He has popularized the telephone service in Little Rock by looking well into meeting all public demands, and his has never been a "public bedamned" policy.

"Mr. Lane will devote his energies and talent to the development of the association, and to making it a great organization for utility men in Arkansas and the Southwest."

Other officers elected by the Arkansas Utilities Association at its fifteenth annual meeting were: J. L. Longino, Pine Bluff, first vice president; Arthur E. Maine, Mammoth Spring, second vice president; R. I. Brown, Little Rock, secretary-treasurer.

EXPLAINS COMBINATION IDEA

Illinois Proposal to Link Bell with Independent Association Subject of Sponsor's Note

Chicago, Ill.—H. H. Knipe, President of the Commercial Telephone and Telegraph Co., Olney, Ill., who was responsible for the Illinois association resolution which suggested admission of Bell interests to membership in the Independent's national association, has written TELEPHONE ENGINEER, explaining his proposal.

Mr. Knipe says in part:

"As to the provision in the Illinois resolution to change the name of the Association and admit the Bell company to representation it was only intended because their membership had worked out with great satisfaction in Illinois, and the Illinois association was ready to recommend the same condition to the United States association, but had no idea of trying to force any such provisions over the sentiment of a majority of membership, especially as there was not a suggestion or an intimation to me from any member of the Bell company that they desired a membership in the independent association.

"Since the Chicago convention there have been a great many expressed a desire to have closer working conditions between state and national associations and it is my opinion that most all states at their meetings will choose a director to serve on the Board of Directors on the U. S. association before their next annual meeting and be fully prepared to make the change is outlined."

Valuation in Rate Making

Chapter X—Depreciation

By Charles W. McKay, Associate Editor

Importance of Unit Costs

It is hard to say which phase of the appraisement problem is more important, the inventory of the physical property, or the preparation of the unit costs. One thing we do know, however, and that is: Assuming honesty of purpose and a reasonable degree of efficiency on the part of the field inspectors, most of the inventory errors will be found compensating. For instance, errors of omission in inventorying the wire plant will probably be nearly offset by errors of commission.

Experience has proved, however, that plant is more frequently left out entirely than duplicated; hence, the almost universal practice of adding a specific allowance to the reproduction cost of the inventoriable property to cover omissions. However, if an erroneous assumption is made as to the labor or material costs when building up the wire unit costs and, if these unit costs are used as a basis for appraising all of the wire plant, it will be readily seen that a serious error may result. Then, again, a regulatory body is much more likely to make a detailed analysis of the unit costs than of the inventory of physical property.

A few errors in the unit costs—even if they are of a minor nature—may tend to cast suspicion on the entire appraisal, including inventory collateral costs and intangible values.

It will therefore be seen that the preparation of the unit costs is a most important feature in the appraisal of telephone properties. This portion of the work should be carried on under the direct supervision of the appraisal engineer, and every unit cost, before it is applied to the inventory, should be subjected to the most careful analysis by the appraisal engineer, and should be checked by every available means. For obvious reasons the unit costs, if determined by a disinterested appraisal engineer, will carry more weight before reviewing bodies than if prepared by an engineer who is an employe of the company submitting the appraisal.

Unit Costs and the Inventory

Long before the completion of the field work the unit cost study should be well under way, and every effort made to complete each set of unit costs by the time the corresponding portion of the inventory is finished. In this way the confusion, so often noticeable during the last stages of a public utility appraisal, may be entirely avoided. The poles and wire inventory is usually the first to be completed in the field. By having the pole and wire unit costs ready for use immediately upon completion of the inventory, this portion of the appraisal may be disposed of in a comparatively short time.

Material Prices at Time of Appraisal

The first step in the preparation of the unit costs consists in the determination of material prices as of date of appraisal. Quotations should be secured from dealers in, and manufacturers of, every class of equipment found in the plant. For equipment usually purchased on a competitive basis—poles, cross arms, wire, cable and conduit—quotations should be secured from a number of concerns. Highly specialized equipment, such as telephone switchboards, private exchanges and subscribers' instruments, can, as a rule, be exactly reproduced only by the original manufacturers, and every effort should be made to ascertain prevalent market prices of various apparatus and material as of the appraisal date.

Determination of Material Prices for Period Preceding Appraisal

Having obtained all possible data relative to fair prices, as of the date of appraisal, the next step involves the determination of corresponding prices for the several years preceding the appraisal. Usually the best way to accomplish this end is to assign one or more men, according to the individual requirements of the case in hand, to the task of reviewing the company's invoices for the several years preceding the appraisal.

For each class of material the following data should be noted: Date of purchase, quantity purchased, name of manufacturer or dealer, the total cost and the unit cost.

Prices that seem abnormally high or abnormally low should be carefully investigated before they are accepted for use in the final determination of the unit costs.

Fair Material Prices for Appraisal Use

With this data—the market prices for the various types of equipment as of the appraisal date and for the several years preceding the appraisal—tabulated in proper form, the determination of fair material prices for use in the appraisal under consideration is a comparatively simple problem.

It is possible that the reader may gain the impression from the foregoing discussion that average prices for the several years preceding the appraisal should be used in all cases. This is not necessarily true. Take, for instance, the present material market. It is undoubtedly true that conditions resulting from the war will continue to affect the material markets for some years to come. Obviously, the appraisal engineer, in deriving fair material prices as of the present date, must take into consideration that fact that, although prices are higher now than they were before the world war, there is every reason to suppose that present market conditions will prevail for some years to come, though with downward trend.

In the last analysis, a determination of fair material prices as of the appraisal date, is dependent not only upon the prevailing prices for the several years preceding the appraisal, but also upon the possible market trend during the several years following the appraisal.

The appraisal engineer must take into account: First, past market conditions; second, market conditions as of the appraisal date; and third, the probable trend of the future material market. In other words, having all of the available facts in his possession bearing on the problem under consideration, the appraisal engineer must use his best judgment in determining fair material prices for the appraisal in hand.

Unit Labor Costs

The labor-cost study is considered after the fair material prices have been determined. Work orders and completed estimates for the several years preceding the appraisal should be carefully reviewed, and all possible data pertaining to the cost of setting poles, placing cross arms, stringing

wire and cable, building conduit, etc., should be tabulated in such a form as to render possible a careful analysis of past and present labor conditions.

Utmost care should be exercised in selecting records of completed work that represent average conditions—conditions that approximate as nearly as possible those that would probably be encountered in reproducing the plant as of the appraisal date.

Obviously, unit costs derived from job orders covering small installations cannot be considered as representative for the purpose under discussion. Unit labor costs are necessarily much higher for piecemeal than for wholesale construction.

Another and a very practical source of unit-cost data will be found in the foremen in charge of the various construction and installation gangs. Many telephone foremen, for their own information, keep a detailed record of the time spent on the various kinds of work falling under their jurisdiction.

It is also true that men who have been in the employ of a company for a long period of time are apt to be well posted as to soil and subsurface conditions encountered in the original plant construction.

Use of Curves to Show Fluctuations of Prices

When all of the available sources of information have been properly tabulated, the resultant data should be a great help in the determination of fair unit costs. In this connection, curves showing graphically the fluctuation of material and labor prices over the period of years preceding an appraisal will be found a material help to the appraisal engineer.

Land Appraising and Purposes

As previously stated, courts and commissions usually have ruled that the appraisal of a utility corporation's land should not be made by a consulting engineer, but rather by a real estate expert. Nevertheless, even if a competent expert is employed for this portion of the work, it is always for the appraisal engineer to carefully verify the findings of the expert.

It frequently happens that appraisals are made for other purposes than as a basis for rate making. The writer has just completed an appraisal of the property of a small telephone company located in a State where public utility corporations are not at the present time subject to the dictates of a public service commission. This company merely desired to gain as accurate knowledge as possible of its tangible and intangible assets, so that it would be in a position to properly administer its financial affairs.

Cases of this kind are numerous, and with the thought that the employment of a separate real estate expert for land appraisal is a rather expensive proposition, it is proposed to consider this subject of land unit costs and land appraisals more specifically than was done in the foregoing treatment of the subject of land inventories.

Differing Opinions as to Theory to Be Used in Land Appraising

The proper method of appraising the land of a public utility corporation is a subject upon which there is a marked difference of opinion between experts. It has been argued that there is no logical reason why land or right of way belonging to a utility company should be considered on a different basis from that of similar property owned by an individual. On the other hand, it is unquestionably true that the development of utility properties has often increased the value of the adjoining land. This is especially true in the case of railroads.

Land along a railroad right of way is obviously much more valuable after the railroad has been built than before. Some experts argue that in evaluating the land or right of way of a railroad company this fact of increased values of adjoining properties should be given due weight, and the railroad allowed to benefit by the general increase in prices.

If this theory is conceded to be reasonable, then it, of course, follows that the utility corporation must suffer the consequences if the use made by it of certain parts of its plant has caused a decrease in the value of the surrounding property. It will be readily seen that the use of land for car barns, storage yards, etc., may be considered objectionable in a residential district, and may cause a decrease in surrounding property values.

The attitude of the courts on this subject is evidenced by the following quotation from the Columbus Southern Railway vs. Wright, 151 U. S. 481: "The value of the land depends largely upon the use to which it can be put, and the character of the improvements upon it."

Methods of Appraising Land

There are two generally accepted methods of determining the value of land: First, the expert method; second, the sales method.

Each of these methods has been subjected to a good deal of criticism. Hence in appraising the land of a telephone company, as already suggested, it is usually advisable to employ both of these methods, so that if one of them is objected to by the court or commission in question the other may be substituted.

Expert Method of Land Appraisal

The expert method, as already stated, consists of the appraisal and description of the land by competent local real estate experts. If the land under consideration is valuable, and if its value forms an appreciable portion of the total value of the plant, it is advisable to employ two or more experts to work upon the problem independently.

In a case of this kind a fair value of the land in question may often be obtained by averaging the respective values submitted by the experts. This latter plan, however, has the disadvantage of disqualifying the experts for testimony before the commission, no expert being willing to take the stand and endorse a modification of his original estimate.

If this averaging plan is employed in determining the value of a telephone company's land, it should be accompanied by a careful and detailed explanation of just how the final value of the land, as submitted in the appraisal was obtained. Then if the court agrees to the propriety of averaging the land valuations submitted by a number of experts, the experts may be called subsequently to verify their individual estimates.

Sales Method of Valuing Real Estate

In a decision, March 8, 1910, the Wisconsin Railroad Commission, in the case of the State Journal Printing Co. vs. Madison Gas & Electric Co., discusses the sales method of valuing real estate. It says: "The sales method of valuing real estate was used partially in the Michigan railway appraisals of 1900-01, and in the light of the experience gained in that work the method was adopted in the Wisconsin steam road valuation made under the provisions of the ad valorem assessment law of 1903. It has since been extensively used in Wisconsin and elsewhere in connection with important valuations of public service properties for both rate-making and taxation purposes, and is generally accepted as a valuable aid to the judgment by experts engaged in such valuation work on a large scale.

The sales method may be defined as a plan, or process, for the systematic collection and comparison of data relating to real estate transfers for the purpose of estimating true market realty values. It consists in a study of the transfers of neighboring property having conditions or characteristics similar to the land whose value is to be determined, and is intended to duplicate, as nearly as may be, the mental or judicial processes ordinarily employed by the so-called "local real estate expert," with a view to arriv-

ing at results approximating those which would be reached by such local experts, acting without bias or suggestion.

Appraisement of Buildings, Account 212

The appraisement of the buildings, like that of the land, is usually relegated by courts and commissions to specialists, as has been previously stated. Most of the State commissions take the stand that the appraisement of the buildings can be much better effected by architects or building contractors than by the appraisal engineer. With all due respect to the regulatory bodies which have established this precedent for building appraisals, it is rather unfair to the appraisal engineer.

Most engineers interested in telephone utility appraisement problems are thoroughly familiar with the telephone business from a purely engineering standpoint, and are perfectly competent to estimate the cost of buildings used for telephone purposes. In fact, it is part of the job of the telephone engineer to be thoroughly posted on building matters. In most cases, he is better able to estimate the cost of the special type of buildings usually required for telephone purposes than are most of the general contractors and architects.

There are so many variable factors entering into the appraisement of a telephone building that it is almost impossible to give accurate unit costs which may be used in building appraisement. Suffice it to say, it is possible to appraise a telephone building by estimating the cubic contents and applying a unit cost per cubic foot, this cost being dependent upon the type of building under consideration.

Buildings also may be appraised by applying a unit cost per square foot to each floor of the building. In the latter case, this unit cost per square foot would vary according to the general use to which the floor in question is put.

Appraisement of Central Office Telephone Equipment, Account 221

The unit costs used in central office equipment are so largely dependent upon the exigencies of individual cases that it is practically out of the question to give any specific data.

As a general rule it may be said that the appraisement of telephone switchboards, frames and racks can be effected by ascertaining the manufacturers' names and the type, ultimate capacity and present equipment of the apparatus in question, referring directly to the manufacturer for prices, as of the appraisal date. These prices may subsequently be modified if, in the appraiser's judgment, they are unduly high—due to some peculiar condition in the material or labor market at the time of the appraisal.

The Pole Line Appraisal

The pole account, it will be remembered, includes poles, cross arms, steps, brackets, anchors and guys. Needless to say, it is necessary to derive separate unit costs for each of these items. With the exception of the poles themselves and the cross arms, it is usually a comparatively simple matter to determine the unit costs as used for appraising the property falling under accounts 241 and 251.

The unit costs usually will be about the same for both exchange and toll equipment, with the possible exception that the toll units will run a little higher than the exchange units, due to the increased costs of doing work at a distance from the base of supplies. In other words, due to the fact that the major portion of a toll line is necessarily located on rural highways, the cost of hauling material to the job will be greater than in the case of exchange pole line construction. The fact that it is frequently necessary for the company to board the men increases the labor item.

Pole Unit Costs

The first step in preparing the pole unit costs is the determination of material prices, not only as of the appraisal date, but also for a period of several years preceding the appraisal. These prices should be determined by getting quotations from a number of competent concerns and tabulating the results somewhat in the manner shown in Fig. 15 herewith. This table is taken from a recent appraisal, and it so happens that the company received its rate increase within the past two months.

The subject of deriving the labor unit costs will be discussed in the January issue.

Vopateks Open Electric Shop at New Prague, Minn.

New Prague, Minn.—S. A. Vopatek, President of the New Prague Telephone Co., and his son, Miles A. Vopatek, have established the Standard Electric Supply Co., at New Prague. The new store will include radio supplies in its merchandise.

FIGURE 15—POLE MATERIAL—PRICES, F. O. B. PLANT UNDER APPRAISEMENT

Height feet	Top inches	1915	1916	1917	1918	1919	Average
15	4	.76	1.03	1.05	1.07	1.19	1.02
15	5	.85	1.19	1.22	1.24	1.38	1.18
15	6	.88	1.24	1.28	1.28	1.42	1.22
18	4	.84	1.12	1.18	1.20	1.25	1.12
18	5	.89	1.26	1.30	1.30	1.47	1.24
18	6	.97	1.32	1.47	1.50	1.60	1.37
20	4	.83	1.02	1.17	1.21	1.50	1.15
20	5	.93	1.14	1.27	1.31	1.71	1.27
20	6	1.17	1.51	1.94	2.02	2.77	1.88
20	7	1.48	2.73	2.93	3.38	3.63	2.83
20	8	3.70	3.68	3.88	4.64	5.14	4.21
20	10	3.70	4.25	4.65	5.40	5.90	4.78
22	4	1.02	.92	1.12	1.51	1.76	1.27
22	5	1.02	1.42	1.62	1.99	2.49	1.71
22	6	1.02	2.35	2.75	3.15	3.65	2.58
25	4	1.75	1.83	1.85	1.88	2.09	1.88
25	5	1.33	1.75	1.98	2.07	2.82	1.99
25	6	2.25	2.58	2.83	3.08	3.95	2.94
25	7	3.23	3.77	4.03	4.26	5.44	4.16
25	8	3.91	4.46	4.78	5.05	6.20	4.88
30	5	3.04	3.36	3.60	3.64	5.24	3.78
30	6	3.96	4.77	5.27	5.27	6.96	5.24
30	7	5.48	6.49	6.99	8.02	9.20	7.24
30	8	6.22	8.27	8.79	9.80	11.10	8.84
30	10	10.50	12.50	13.50	14.00	16.00	13.30
35	4	4.85	5.10	5.10	6.10	7.00	5.63
35	5	5.02	5.33	5.33	6.35	7.05	5.82
35	6	5.93	6.47	6.52	7.50	9.20	7.12
35	7	9.22	10.27	10.30	11.30	13.60	10.74
35	8	10.70	12.83	12.86	13.86	16.26	13.30
35	10	13.50	15.00	16.00	17.65	19.65	16.36
40	5	8.07	9.15	9.24	10.24	11.36	9.61
40	6	9.54	10.58	10.56	11.66	13.21	11.11
40	7	11.72	12.83	12.86	13.86	16.26	13.49
40	8	13.74	15.34	15.42	17.42	19.92	16.37
40	10	15.55	21.25	17.01	21.36	23.36	19.70
45	5	12.40	13.40	15.40	15.96	17.95	15.02
45	6	12.40	13.40	15.40	15.95	17.95	15.02
45	7	14.24	15.35	15.42	17.42	19.92	16.47
45	8	15.72	18.90	19.04	20.86	23.57	19.62
45	10	19.25	21.25	23.25	24.50	28.30	23.27

(Continued from page 16)

contract arrangement which has made this all possible has passed the essential test. It has been of far greater vaule to the public than what the public has paid on account of it.

Parent Service Costly

You have sometimes asked for the cost of the services under the contract performed by us within a state. It is impossible for us to ascertain the cost of the services rendered to an associated company for any state. Let me give you an example: We spent over $400,000 in the state of Connecticut on study and experimentation with the railroad to determine how our service and the electrical transportation service could exist side by side without detriment to our service.

That was not a service primarily for the state of Connecticut. It was a service for the whole system. We are spending this year, and every year, large sums in the improvement of the art of telephony with on knowledge as to where and when the first application of those improvements will be made. There can be no way of determining the cost of such services as these by states.

Then the question is sometimes asked: "What is the cost of these services for all of the states, and what does the American Telephone & Telegraph Co. receive for them?"

From our point of view, the whole purpose and business of the American Telephone & Telegraph Co. looks to a single end—furnishing a national telephone service. For that purpose it was organized; for that purpose it owns stock in the operating companies; for that purpose it owns stock in a manufacturing company; for that purpose it spends money upon a great variety of service to the operating companies; for that purpose every dollar of its expense is incurred.

Our income from these operations comes from interest, dividends, from the earnings of the long lines department, and from payments under the license contract. These sources of income are separate and distinct, so that the amount of the income derived from any particular source may readily be ascertained with substantial accuracy.

Expense Allocation Difficult

This is not true as to the expense items. They are all devoted to the single purpose of the company, and it is not possible under the system of accounts prescribed for the company, or under any system of accounts which we have been able to devise, accurately to allocate expenses of the company specifically to that portion of the license contract which covers the general services rendered to associated companies.

This question has interested us as well as you, and we have tried to solve it from time to time. Our estimates have led us to conclude that we spend on these services substantially all or more than the 4½ per cent payments.

Another question sometimes asked is: "Why is the payment for these services made in the form of a percentage upon revenue?"

Since it began to be made in that way about 20 years ago there have been many changes in the official families of the companies, parties to the contract. Many men coming into positions when that contract became one of their responsibilities have themselves asked that question. No one has suggested a better or fairer way.

Any attempt to apportion values to different parts of the business would meet all of the difficulties that would go with an attempt to apportion value by states. It has seemed to me that the method was the logical one. The benefits from the service accrue in benefits to the public in lower rates or better service. How can they be measured better than by a relation to what is paid for service?

The better case a man has, the more it is to his interest that the one passing upon the merits of his case should be well informed as to his case. Obviously, a commission, keeping in close touch with the operations and results of operations of a public service, will be better informed than any agency which only occasionally attempts to inform itself on the occasions when a change in the charges to the public is to be considered. That is why we have consistently advocated regulation by commissions. In 1913 Mr. Vail made this statement:

"We believe in and were first to advocate state or government control and regulation of public utilities; that this control or regulation should be by permanent quasi-judicial bodies, acting after thorough investigation and governed by the equities of each case; and that this control or regulation, beyond requiring the greatest efficiency and economy, should not interfere with management or operation.

"We believe that these bodies, if they are to be permanent, effective and of public benefit, should be thoroughly representative; they should be of such character and should so conduct their investigations and deliberations as to command such respect from both the public and the corporations that both will without question accept their conclusions."

We believe that the best results for the service and, therefore, for the public will be attained by a relation of confidence and co-operation between the commissions and ourselves. We intend to deserve the confidence of the commissions by the utmost frankness and straightforwardness in our dealings with them, and we hope for a time when the commissions will be kept so well informed continually as to our operations and results and problems and necessities that the great expense of occasional investigations may be saved.

We are making systematic efforts to widen the ownership in the Bell system because people will inform themselves and their neighbors about the operations of an institution in which they are partners, and we welcome every epportunity to increase the knowledge of our operations among telephone users. No institution is more publicly owned. Its plant has been built out of savings of the people. It is being extended out of such savings. It is the people's institution more than any other.

From the character of its ownership and because a large proportion of the people of this country depend upon the Bell system for their telephone service, its management and operation is a trust and obligation to the public which must be fulfilled to the satisfaction of the public.

It will not be completely fulfilled until rates are low enough to impel everyone to have a telephone in his own residence or office who ought to have one for his own convenience or the convenience of the country. Consistent with this belief, I feel safe in saying that the desirability of lower rates is more in our minds than in the minds of the commissioners.

The value of the service to the large user is so much in excess of its cost, and so much increased by a wider extension of the service, that I am firmly of the opinion that whenever a reduction is possible it should be in the charges to the small user. It seems proper to me that commissions should take value into consideration in the making of rate schedules and I think that they should take it into consideration in comparing costs of service.

The interest of the public and our interest are identical in the direction of greatest value which includes greatest extension of the service at fair rates. Sound, efficient and economical regulation involves, therefore, co-operation between the commissions and our companies to produce that result. It involves, when the time comes for a change of rates, a study between them as to what increase or decrease in revenue is indicated, followed by another study on rates with a view to effecting the necessary change in such

a way as to make the service available to the greatest number.

I can imagine a commission, in fulfilling its obligations, calling to account a company not sufficiently alert as to its conditions and instructing it that its rates must be increased so that its service to the public may not be in danger. There have been cases where that kind of caution was necessary.

Commission regulation, on the whole, has been satisfactory. We have intended to present our views to them fairly, completely, and in a straightforward way. We haven't always reached our standards. Commissions, as a rule, have manifestly intended to be judicial and fair. Occasionally they have temporized. They have during the past three or four years passed through a very difficult period in which, in order to maintain service of the utilities, rate changes have been advances and not decreases.

Since the termination of the period of federal control the associated companies of the Bell system have been before state commissions and other regulatory bodies in 205 separate proceedings, some of them involving the change in a rate in a single city, some of them involving changes in rates in practically all the cities of a state.

The decisions of the commissions have been accepted in all but 20 cases, although in some of these cases accepted it has been felt by the companies that they were not getting all to which they were either legally or fairly entitled. If there seemed even a possibility of going on without detriment to the maintenance and extension of the service, they accepted the decisions. When we have appealed from the commissions to the courts, it has been with reluctance and because we believed it our duty in order to preserve and extend the service. In the 20 cases which have been taken into the courts, decisions have been renderered in 11. In all but one our contentions have been upheld.

Take the Bell system as a whole; it has an investment of about two billions of dollars, between 200 and 300 thousand employes—serves about nine millions of customers directly and is responsible for returns to 400 or 500 thousand stock and security holders. That puts it among the largest business enterprises of the world. I do not mention this as a glorification, but only to call attention to this advantage to the public in dealing with such an institution.

Can't Afford Loss of Esteem

We are about as conspicuous as a pyramid in a desert. We cannot afford, at the risk of losing any part of public approval, to vary a hair from the course toward the objective which we are convinced is the only objective that the public will finally approve. And that is the best and broadest service which can be given at fair rates. We must have its approval all along the course, which means that none of our methods of operation or of our rules of conduct must fall below the highest standards.

I have been talking about the Bell system of today, but we are all looking forward to the task of tomorrow, and if we are to meet our increasing obligations, we must have the confidence and co-operation of the public and of you, its representatives.

We are studying the probable telephone requirements for the next five, ten and fifteen yers; we are considering the new capital that will be required to meet the demanded growth; we have men studying the innumerable inventions and technical improvements without which we could not reach our objective. We have to think in big figures, big figures for labor, material and financial resources, for if we did not, we would be overwhelmed by the increasing public demands.

If we can make you see our objective as we see it, if we can make the picture of the future live in your minds as it does in ours, I am confident that you will see it as an objective of far-reaching national importance, which commands the utmost seriousness on your part and on our part, and that from that seriousness should come such co-operation as will bring the results which the country demands.

Independents Submit a Case

Chief of Independents Gives Line-up of Industry—Shows His Companies Have Earned Right to Commission Consideration—Asks for Righteous Rate Classification

By F. B. MacKinnon

(President United States Independent Telephone Association)

There is no dispute between Mr. Thayer's company and our organization as to several questions. In the first place, we agree that there should not be duplicate telephone plants in any community. And in the second place, we agree that there should be regulation of our business by you.

We disagree sometimes as to operating practices—the Independent companies believing in Independent methods, Independent equipment and Independent management; and Mr. Thayer and his associates in the Bell organization believing most thoroughly in their own methods.

We agree, as Mr. Thayer has said to you, that there should be two groups in the telephone industry; that this is desirable from the public standpoint. We believe that it is most desirable from the standpoint of the industry.

Does the public, whom you represent, believe that there should be two groups in the industry? That is the first question that you must answer. You represent the public in control of the two groups.

If it is the belief of the public that there should be but one organization operating the telephone systems of this country, that belief will be expressed through you in your regulation of these companies. That is the only way we get your answer. That is the only way the public finds whether its influence has been properly expressed.

There are in this country 600 points where our companies are competing by duplication with the Bell company. Three hundred out of these 600 points are in the state of Pennsylvania, where there have been legal restrictions against the consolidation of telephone companies. These restrictions, so far as the legislature is concerned, have been removed, but they are awaiting the final approval of the act by the supreme court. Therefore, there are, outside of the state of Pennsylvania, 300 communities in which there are both Bell and Independent exchanges.

It has been the co-operative effort of the Bell organization and of our organization, to clear up these duplicate points, to the best of our ability protecting the service in every instance.

It should be remembered, when you read of the attitude of the Independent towards the Bell, and the Bell towards

the Independent organizations, that both of those organizations have foremost in their minds the one thought —service to the public. And when it resolves itself into a question of who shall operate at a point, the real answer always is: "He who best can serve the public at that point."

Frequently we find it necessary to say to the Bell company: "We cannot carry the load there; that is your job." And sometimes they say to us: "We do not want to go in there; that is your job." Service to the public is the aim of all of us.

A Picture of the Industry

As Mr. Thayer has said to you, there are some 14 million telephone stations in the United States, of which nine million are operated by the Bell companies. Of that nine million, some four million, in round figures, are in the 25 principal cities of the United States, leaving five million outside of those cities, in which territory we also operate five million stations.

The question that we ask of you today is: Is it your desire that the Independent group shall continue to operate in the field which it now occupies? Shall it continue to operate those five million stations with their constantly increasing growth, growing today at the rate of some 250,000 to 300,000 telephones a year?

These five million Independent stations are located in 15,000 communities in the United States, and are operated by nine thousand separate units. And by separate units, I mean separate units—practically no one of these units controls the other unit.

We have an association in practically every state which has no control over the units within the state—and we have the national organization, which has no control. Our association attempts to crystallize opinion and express that opinion for the organization. The Bell company operates 150 units, 14 of which are their large subsidiary companies. The Bell companies are operating in some 6,000 communities and our companies in 15,000.

This, in brief, pictures to you the telephone situation in the United States. It is not necessary for me to tell you where we operate, to describe to you some of those small crossroads exchanges, nor to call your attention to some of our large efficient city exchanges. You have the picture, I know, before you. We are operating in practically every state in the Union, and are doing our best in an Independent way, to cover the field.

We maintain that there are some communities in which an exchange can only be operated by Independent methods. We grant you, when the matter becomes impersonal, where it becomes a matter of the investment of large sums of money, then the larger organization must take up the task. But, as long as the personal element enters into it, as long as neighborhood acquaintance counts, the best method is by the Independent method.

It is not necessary for me to say anything to you about the history of the telephone situation in the United States, nor about that early time when there was duplication in practically every town in the country, when we were fighting and had a glorious time together. There was no fight, unless perhaps a bank fight, which was a harder fight than a telephone fight.

It is not necessary for me to call your attention to how many a plant was started, or how some of our plants would refuse to take on the toll lines of Mr. Thayer's organization —and in order to get into that territory, that organization cultivated the establishment of a mutual company; or how we, not being in the field, went in and organized a company of our own, and ran our toll lines out from it —all resulting in duplication of exchanges.

It is not necessary to call your attention to the fact that the growth of this independent movement resulted in the establishment of large factories and manufacturing concerns which are manufacturing for us today our telephone equipment.

But I call your attention to that in order to show you that, growing as we have, we developed managers and engineers, and we have developed factories that are our own. Our problem today is to maintain those factories, to maintain that engineering force, and to maintain within our ranks efficient managers.

Independent a Real Group

And there is the point that I want to bring home to you today, to you collectively—not to you as individual state commissions, but to you collectively—that the Independent is a national group. It cannot be considered in any other way.

If those of you who are handling the affairs of the telephone business in one state cannot take into consideration the fact that in the other states there are individual parts of the same industry as are the units in your own state, and if you do not recognize that they are a part of a national group, you are overlooking an essential part of telephone regulation today. Our units in one state cannot maintain themselves as an Independent organization unless our factories are maintained. Our factories cannot be maintained as national factories unless that national group be maintained.

You will ask me perhaps, why the Independent companies sell out. I have been asked that every time the newspapers carry the notice of an Independent company selling out.

Our Independent companies began their work some 25 to 30 years ago. Many of the men who started those companies now have reached advanced years, where they want to be relieved of the load. Others who have come in since the beginning of those small companies now find themselves unable to keep pace with the financial situation and with the problem of management. But the one thing that bothers them more than anything else is the problem of regulation.

The average man in this country—I think I am safe in saying it—the average man in this country dislikes a lawsuit. And the average operator of a telephone property regards a case before a commission as a lawsuit; and it is with the greatest reluctance that he goes before this court and takes this matter up with them. Also, he is not by temperament equipped in many instances for the new accounting, and for the submission of evidence to you.

The result is that in many instances he throws up his hands and says: "I must get out of this business, and turn it over to someone else who is capable of handling it."

And then comes our problem. In such a case we must take over that property—because, as I said in the first place, our first object is that of service to the public—by securing another man or company to do it.

Our problem is the problem of every industry—the problem of men and money. Where are we going to get the men to carry on the load, if we can get the money? And if we cannot get the men, we cannot get the money.

These men who find themselves unable to carry the load any longer, for one reason or another, come to us and say that they must get out. If we cannot carry that load in that particular territory, if we cannot substitute for that man, or cannot relieve an estate of a load which the estate cannot carry, then there is only one recourse —and that is to go to our other group in the telephone industry and say to them: "Gentlemen, here is a load that you must carry."

I want to say to you that the working out of these situations is today, and has been for years, a source of anxiety to us in the Independent group because we feel our responsibility to the public in maintaining that group, since, as I said in the first place, we

think it necessary that there should be two groups in the telephone industry.

And I want to say to you also that in our co-operative efforts with the Bell organization they have generally been fair, they have generally evidenced a desire to be fair; and I have seen a few cases where they appeared to attempt to take advantage of one of our company organizations.

But there is a problem to be solved; and if we cannot solve it, we must not simply act the part of the dog in the manger and say to the other fellow: "You have got to stay out."

Need Commission Help

But we can go just so far in supplying money and men. We could go farther if we had the positive assistance of the state commissions in recognzing the necessity and desirability of a strong Independent group in the industry.

Many of our men complain that efficiency and economy in operation are penalized by regulation—by regulatory methods. And it seems to me that there are grounds for that complaint. I could point you to a number of efficient Independent organizations in this country—I will not name them, but you can name them yourselves, knowing your own states as you do—Independent organizations in this country that are operating their plants so efficiently that the comparison with similarly operated plants in the same territory by the Bell organization is very favorable to ours.

Yet, on account of the rigid rules laid down either in your law, or by your procedure, our companies are penalized for that efficiency rather than encouraged for their ability to secure better revenue, better net income, and better returns—are denied the encouragement which always should go to the individual for having done a piece of work a little better than the other fellow.

Has not the time come in the regulation of telephones for you to be able to base the rate at various sized exchanges upon your experience as to what should be paid in a certain community? Has not the time come when you can get away from the rigid appraisal and inventory, and grant to a man a reward for efficiency? Has not the time come when you want to say: "In our approval of the Independent group we want to aid them in every way, and if they can operate more economically than the other fellow we should not penalize them and hold them down to the lowest possible return?"

Has not the time come when the state commissions of this country shall stop devoting their entire time to appraisals and accounts, and shall have their men and their staff go out and inspect service? Shall they not go out and say to the communities of the country: "We are here to see what kind of service you are getting. We are here to call this company to account for the service. We have been in existence so long that we know what the rate ought to be in your own community. But what we are demanding now of the company that is serving you is that they shall give you service." Has not the time come for you to shift about?

I know the restrictions of the law. I know the restrictions of the procedure that is laid down for you by those laws. But has not the time come for this organization, which is doing such efficient work in getting better regulation, to state publicly to all of the state legislatures that a uniform method of procedure in telephone regulaton should be adopted, a method whch will enable you to recognize economy and efficiency, and will enable you to devote the time of your staff to the improvement of the service rather than raising rates.

It seems to me that it is a problem we should work out—you, and the Bell companies and ourselves speaking for the telephone industry to the commissions.

The larger organization necessarily incurs a greater expense in operation—we find that in our own organizations; the Bell company finds it in its organizations. It is necessary under present procedure in fixing the rate for a given sized exchange to fix that rate based upon the operating investment and the operating receipts and expenses of the larger organization.

There is hardly a state commission but knows what is a justifiable rate to the Bell company for operation of a particular exchange in that territory—one that will make a reasonable return on the investment. My question to you is this—why, if the Bell company is granted a sufficient rate at Podunk, is the Independent company, which is operating the same sized exchange more economically over at Coal Center penalized and made to operate that exchange at a lower rate?

Wants Rates Classified

Why can't we have a certain classification of rates? That is my point. Once that classification is reached and arrived at, then instead of penalizing us, you encourage us, and you stimulate the whole industry.

I would not have you for a minute understand that I am suggesting that you penalize the Bell company. The Bell company must earn a reasonable return. They have a wonderful system, and their organization is absolutely necessary to the whole working out of this telephone problem. But when we, operating by our methods, are able to operate more economically, and when we bring to the communities the personal elements which cannot be brought in by the greater organization, certainly we ought to have our reward.

Once that procedure is established then, as I have suggested to you, you can insist upon service standards that you cannot now insist upon; and you can divert the attention of the engineering staff to the improvement of service, and thereby render a real service to every community in the state, which you are now prevented from doing because of the law and rules of procedure.

Southern Traffic Men Instructed in Handling Toll Traffic

Atlanta, Ga.—District Traffic Managers of the Southern Bell Telephone Co. have been given an intelligent, first hand understanding of toll operating through a series of toll training courses conducted by the Company. The entire course covered six weeks and was divided into two parts. The preliminary course of four weeks was based on the student operator's training course and included class room work and actual experience in handling commercial traffic. One week was devoted to training in inward and through operating and recording work, two days were devoted to a supervisor's training course and three days to service observing work. The second part of the course covered central office management. During this period the men were assigned to specific problems requiring the application of thought, judgment and knowledge of operating methods. Among the men who took courses were not only the District Traffic Managers of the Southern company but officials of connecting companies, including W. C. Darrow, District Traffiic Manager, Carolina Tel. and Tel. Co., Tarboro, N. C.; J. C. Gray, District Traffic Manager, Piedmont Tel. and Tel. Co., Gastonia, N. C., and L. H. Whitehead, District Traffic Manager.

Washington, D. C.—Within seven months radio telephony increased in the United States from 5 to 320 broadcasting stations, from probably less than 200,000 to 1,500,000 receiving installations.

Type A 27 Pole Cable Terminal

Type A27
Pole Cable Terminal
Fits Pole
No Gaining

Equipped with P495
Self-Cleaning Sawtooth
Discharge Blocks
Without Extra Charge

Reliable Electric Company

3145 CARROLL AVENUE CHICAGO, U. S. A.

P495

WIRE TABLES (HH-2-10)

PROPERTIES OF MATERIALS USED FOR WIRES

PROPERTIES OF COPPER. Copper stands second in the scale of conductivity (Silver first), and is therefore one of the most important materials used in electrical construction. Its conductivity varies with the percentage of impurities present in the copper, the temperature, the method of manufacture, whether in a hard or soft condition, and the amount of working (Drawing, etc.) which it has received. Because of its greater strength in resisting the stresses due to supporting it over long spans, the "Hard Drawn" copper wire is used mostly in outside transmission lines. The annealed wire, or wire which is softened after drawing by heat treatment, is used for coils, short wiring, insulated wire, etc.

As a general rule, the conductivity of a copper wire is improved by repeated working, that is, repeated passes through the drawing dies improves its structure. For this reason, the conductivity of small wires is generally somewhat better than that of large wires since the smaller wires are given more passes through the dies. The conductivity of soft annealed wire is somewhat better than that of the hard drawn wire as received from the dies, but the strength is very much less.

Chemical impurities, such as the residual alloying metals left after refining the copper have a very great effect upon the conductivity and for this reason, the best copper for electrical work is that which very closely approaches 100 per cent purity. The effects of iron, arsenic, silicon and phosphorus are particularly noticeable in reducing the conductivity, even when present in very small percentages, and for this reason every attention must be paid to the refining processes used for producing electrical copper. The presence of one per cent of phosphorus, for example practically doubles the specific resistance. Arsenic, which is present in nearly all copper ores is also to be guarded against in refining, since one per cent of arsenic will reduce the conductivity by practically 33 per cent.

PROPERTIES OF CHEMICALLY PURE COPPER

Specific Gravity	8.890
Weight in Pounds per Cubic Inch	0.321
Weight in Pounds per Cubic Foot	550.4
Electrical Resistance, ohms per cubic cm., 0°C.	1.59×10^{-6}
Electrical Conductivity, ohms per cubic cm., 0°C.	6.27×10^{5}
Electrical Conductivity, Silver = 100	97.67
Melting Point, C°	1100
Latent Heat of Fusion, Kilo-Calories	43.3
Thermal Conductivity, gram calories per cubic cm., per C°	0.82
Temperature Coefficient of Electrical Resist. C°	3.88×10^{-3}
Temperature Coefficient of Expansion, C° (0°-100°C)	1.67×10^{-5}
Temperature Coefficient of Expansion, F° (0°-100°C)	9.30×10^{-6}
Specific Heat at 17°C	0.09244
Specific Heat at 100°C	0.09422
Specific Heat at 200°C	0.09634
Specific Heat at 300°C	0.09846

Copper wire is approximately 1 1/7 times as heavy as an iron wire of the same size. As a rough guide we may say that the resistance of a copper wire increases about 0.24 percent for each 1°F. increase in temperature. This is much less than the temperature effect with iron, the latter having a factor of 0.39 percent.

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TELEPHONE ENGINEER

COMPILED BY
J. B. RATHBUN

HH-2-10

NEVER CREEP
THE NEVER CREEP CANNOT CREEP IT PULLS AGAINST THE SOLID UNDISTURBED EARTH
ALL DISTURBED AND MOISTURE EFFECTED EARTH IS BACK OF THE NEVER CREEP

NEVER-CREEP

Here's all there is to installing a Never-Creep Anchor—bore a hole with an ordinary earth auger, drive in the guy rod, hang on the anchor plate, attach the guy wire to the patented Thimbleye.

Now you have anchorage that is as permanent as it can be. There is no pull against disturbed earth—no chance of slipping or creeping. Consider the thrift and ease of installation, the rigidity and strength of the anchorage and the permanent nature of the materials used in Never-Creep anchor construction, and you will very quickly decide that the Never-Creep is the anchor for you.

Write us for complete details of the Never-Creep with the valuable Thimbleye Feature

CHANCE COMPANY

ANCHORS PROTECTORS BRACKETS
SOCKET WRENCHES BACK TRUSSES

CENTRALIA, MO.

WIRE TABLES (HH-4-10)

PHYSICAL PROPERTIES OF VARIOUS WIRES

PROPERTIES OF UNIT WIRES. In the following table is given the weight and resistance of various materials in terms of the CIRCULAR MIL-FOOT, the lengths being in feet while the resistance in ohms.

COPPER:	
Pounds per Circular Mil Foot	0.000 003 03
Resistance per Mil Foot at 15°C	10.074
GALVANIZED IRON:	
Pounds per Circular Mil Foot	0.000 002 64
Resistance per Circular Mil Foot	74.548
GALVANIZED CRUCIBLE STEEL:	
Pounds per Circular Mil Foot	0.000 002 64
Resistance per Circular Mil Foot	116.858
ALUMINUM:	
Pounds per Circular Mil Foot	0.000 000 916
Resistance per Circular Mil Foot	16.16

The above figures form the basis of weight and resistance measurement, the resistance increasing in direct proportion to the length of the wire and inversely as the square of the diameter. The unit "Ohms per Circular Mil Foot is frequently used in formulas for computing voltage drop. It should be noted that the resistance of soft drawn wire is slightly less than that of the hard drawn wire. The table above is based on soft drawn materials.

SPECIFIC RESISTANCE OF METALS. The conductivity of the various metals is greatly affected by the impurities which may exist in the metals, hence in commercial wires which contain varying amounts of impurities it is impossible to give values which will apply exactly to every individual case. In the following table (Taken from Smithsonian Tables) are the averages of the values obtained from various commercial samples.

SPECIFIC RESISTANCE OF METALLIC WIRES

		Condition	Resist. in Ohms of Wire 1 Sq. Cm. in Section, 1 Cm. Long 0°C.	Resistance 1 Mil. Foot At 20°C.	Resist. Increase (Percentage) Per 1C.° Increase At 20°C.
1	Silver	Annealed	1.460	8.781	0.377
	Silver	Hard Drawn	1.585	9.538	***
2	Copper	Annealed	1.584	9.529	0.388
	Copper	Hard Drawn	1.619	9.741	***
3	Gold	Annealed	2.088	12.560	0.365
	Gold	Hard Drawn	2.125	12.780	***
4	Aluminum	Annealed	2.906	17.480	....
5	Zinc	Rolled	5.613	33.760	0.365
6	Platinum	Annealed	9.035	54.350	....
7	Iron	Annealed	9.693	58.310	....
8	Tin	Rolled	13.180	79.29	....
9	Lead	Rolled	19.140	115.10	0.365
10	Mercury	Material Fluid	94.070	565.9	0.387
					0.072

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TELEPHONE ENGINEER

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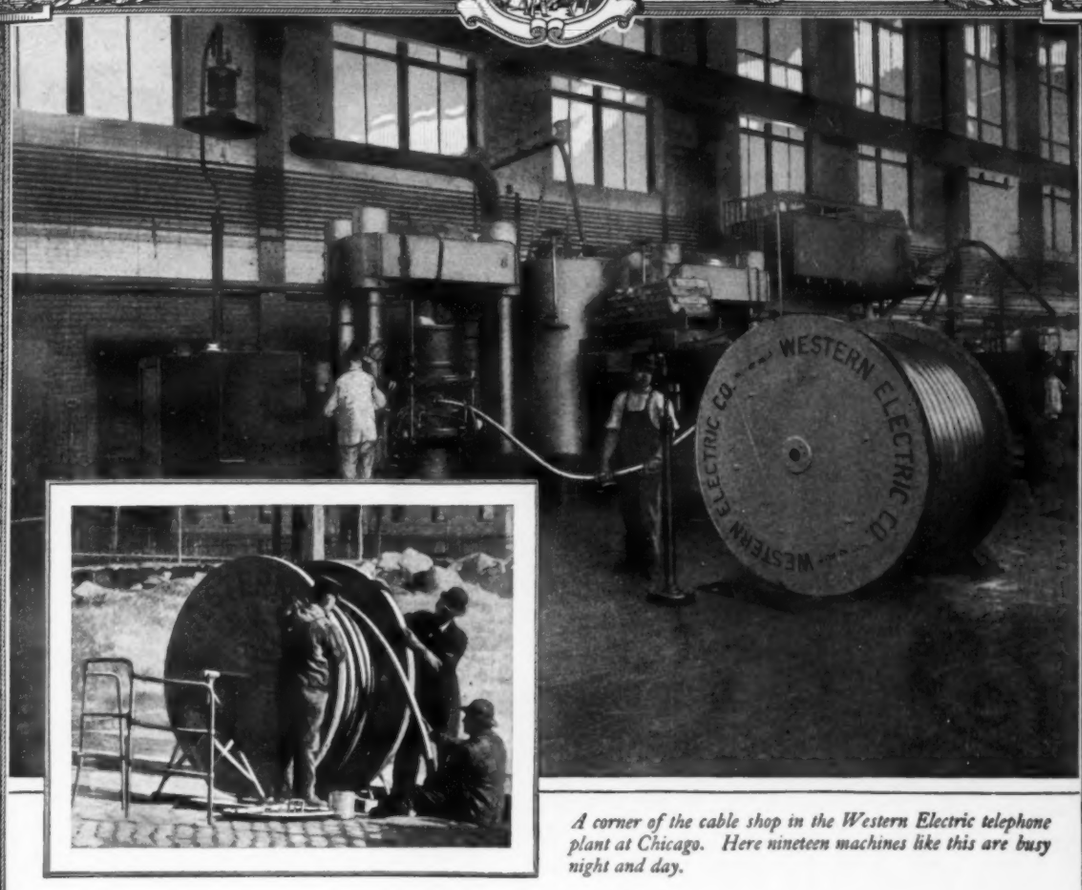


A corner of the cable shop in the Western Electric telephone plant at Chicago. Here nineteen machines like this are busy night and day.

A familiar scene, and what's behind it

To you who have wondered how telephone cable is made, a simple answer would be "One machine winds the wires and another puts a lead covering around them."

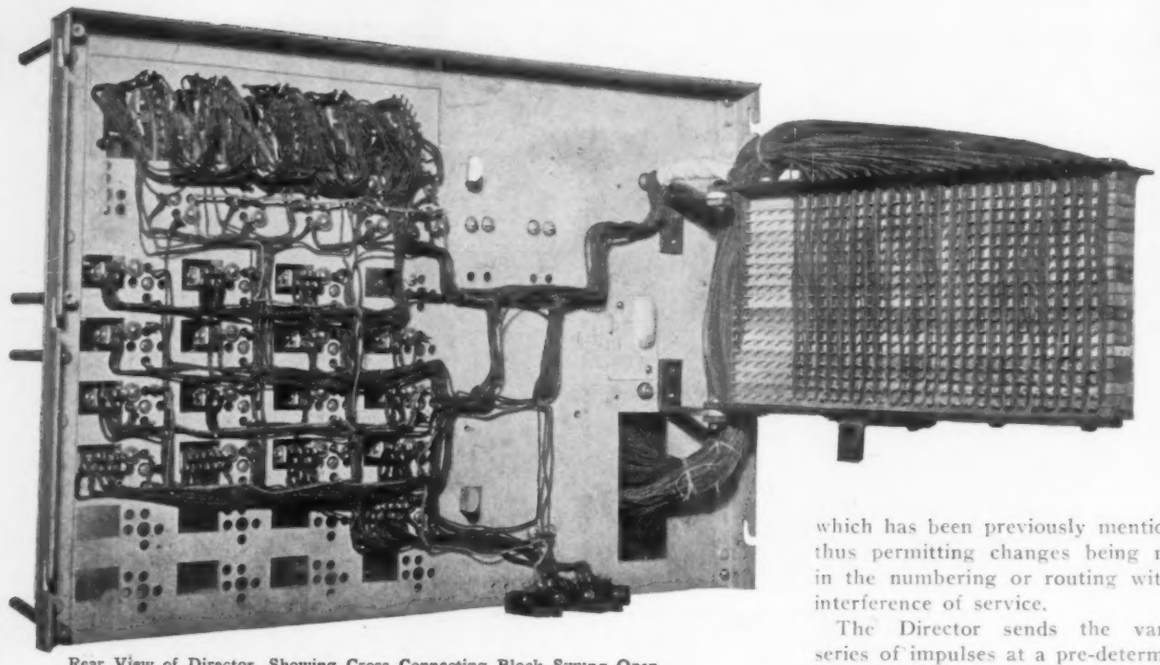
But that gives small idea of the task in producing 6000 miles of cable each year from more than two million miles of copper wire, each wire separately insulated and all compressed into a diameter of an inch or two and sealed with a covering of molten lead.

Western Electric is the largest manufacturer of telephone cable in the world.

Yet all this is only one phase of the Western Electric Company's work of making telephones and telephone equipment—and making them in great quantities, yet with extraordinary accuracy.

Western Electric

Since 1869 Makers of Electrical Equipment



Rear View of Director, Showing Cross Connecting Block Swung Open

(Continued from page 18)

The Director has one hundred sets of bank contacts, and when used with the non-digit type director-selector, has mechanical facilities for 100 two letter office designations. When used with the digit type director-selector, it has facilities for 1000 three letter office designations.

With the types of dial lettering shown in figures 1 and 2, it is not possible to use the full 100 two letter designations or the full 1000 three letter designations referred to above, both on account of unpronounceable combinations of letters representing the different numerals and on account of numerical conflict of different office names.

In spite of these limitations, the requirements of even the largest possible metropolitan areas may be easily taken care of by the use of three letter office designations.

From the preceding it can be seen that either a two or three digit office code can be arranged to direct calls over one, two, three or four links to reach the terminating office, and it is felt that such provision will be adequate for most cases. By adding another set of wipers and a contact bank to the digit switch in the Director.

As soon as the registration of the office code has been completed the Director begins sending the series of impulses and if, in the meantime, any of the numerical digits have been registered these will be sent in turn. After the entire call has thus been sent the Director is instantly cut out of circuit and made available for another call.

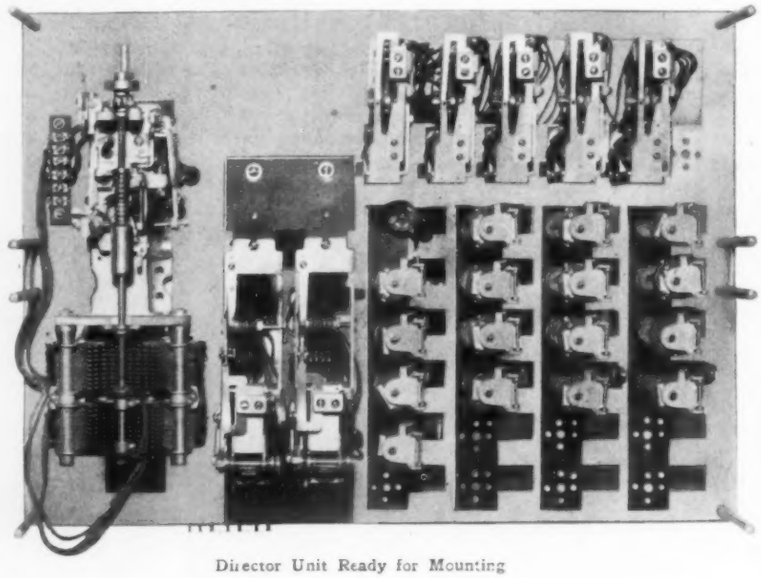
If, when a Director has been seized there is a lapse of time greater than some pre-determined interval, say thirty seconds, the Director is cut out of circuit and made available for another call. Provision can be made so that, in case of an abnormally delayed call that part of the connection which has already been set up, will be released, and the call will be automatically routed to a moniteringing operator, after which the Director will be released and made available for another call.

Equipment Assembly

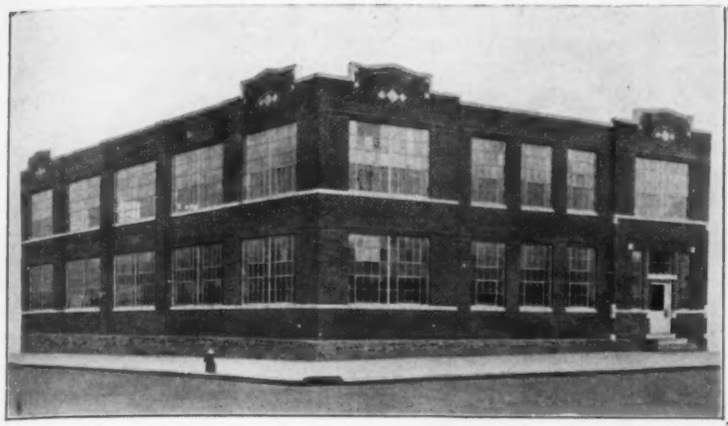
The equipment group forming the Director is assembled on a demountable base much in the manner of Strowger selector and connector switches. A complete director occupies approximately the space required by four selectors. Each Director has its own simple cross connecting block which has been previously mentioned, thus permitting changes being made in the numbering or routing without interference of service.

The Director sends the various series of impulses at a pre-determined rate and allows ample time between digits for the selector to search over the maximum of ten trunks. This searching time will not exceed one-third of a second. There is, therefore, no need for revertive control to allow the selector to pick a trunk before the Director sends its next series of impulses. Where the speed of searching is slow or the field to be searched is large, revertive control is necessary, otherwise ample time would have to be allowed for the maximum searching time over the entire field and this would then penalize all other calls. The Strowger system, however, having only a small field can allow a short uniform searching time and avoid the complications of revertive control.

In large metropolitan areas it is not efficient to have direct trunks from every office in the network to every



Director Unit Ready for Mounting



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PLANT - GARWOOD, N. J.

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Blake Insulated Staples

Unequalled for telephone and bell wiring. The fiber insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for samples.

Blake Signal & Mfg. Co.
BOSTON, MASS.

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Buy it of your jobber in ½-lb., 1-lb. and 5-lb. blue and white enameled cans and 50-lb. cans. New prices for 1922.

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RUBBER COVERED TELEPHONE WIRES

for every conceivable use. Braided, Leaded and Iron Armored Telephone Cables, Conductors straightway or paired

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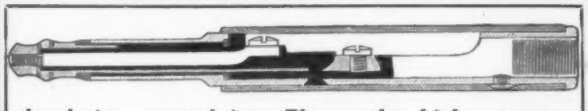
Indiana Rubber and Insulated Wire Co.

JONESBORO, INDIANA



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Plugs of All Designs — Write for Information

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are guaranteed as to their unexcelled dependability by long and successful service.

They represent the greatest advancement in telephone cable manufacture.

Write our nearest office about your requirements

Standard Underground Cable Co.

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other office. In manual practice tandem trunking switchboards located at certain trunking centers are used to take advantage of the efficiency offered by large groups of common trunks, but since this requires an additional operator at the tandem point there is an increase in cost of operation and a greater chance for errors; the plan therefore has its limitations. However, with the use of the director and its ability to set up any required number of links to reach the terminaling office it is possible to use the tandem trunking principle to its utmost, being governed entirely by considerations of plant economies, without regard to traffic and operating complications that would have to be considered under manual conditions. On account of the cross connecting facilities in the director, tandem trunking can be arranged at any time and changed from time to time as required.

With the use of the Director the Strowger Metropolitan System offers the following important features, its makers say:

1: The system uses no new or untried apparatus. The Director consists of standard parts combined in new ways.

2: Due to an improvement in the arrangement of the letters on the dial, many subscriber errors are avoided.

3: The use of the Director introduces no undue delay to the subscriber, after the last pull of the dial.

4: The numbering scheme is conformable with any trunking scheme, so that changes can be made in one without affecting the other, by means of changes in simple cross connections.

5: Existing exchange names can be retained in practically all cases, except where there is conflict between the numerical equivalents of the letters for two office codes.

6: The Director can be added to existing Strowger two wire installations at any time that it becomes desirable to dissociate the numbering and trunking schemes.

7: The Director is in use only during the setting up of a call, after which it is automatically cut out of circuit and is available for another call.

8: If the Director is seized and no call registered within a pre-determined time, the Director is released, thus preventing equipment being tied up in case of an outside cable failure causing a number of grounded or crossed lines. In case the subscriber delays after having dialed part of the call, provision can be made to route the call to an operator.

9: The system provides for straight metered service or for zone metering with varying multiple charges for the several zones, and in combination with this, can also register initial continued time intervals.

10: The system provides for both post-payment and pre-payment coin box service, with facilities for automatically interposing an operator on calls beyond the unit charge area.

11: Party line service can be provided.

12: The system provides for toll and long distance service, maintaining approved transmission and supervisory standards.

13: The system invariably uses the most economic trunk groupings, without imposing additional trunk hunting time.

14: By means of the Director, calls to various offices that would ordinarily require only a few trunks are combined and routed over common groups of trunks via manual or automatic tandem offices.

15: When loaded inter-office trunks are used suitable taper coils are associated with each trunk.

16: By an economical method of grouping, P.B.X.'s requiring a larger number of trunks are readily served.

17: The Strowger System readily adapts itself to the various requirements of the transition period, regardless of what plan or plans of interconnection are used.

18: Any number of offices up to several hundred can be handled by the system, without waste of levels on the office selectors.

19 Strowger equipment does not require buildings of special design, and where floor space is available can be installed in existing manual offices.

20: Out of more than a million automatic telephones in use throughout the world more than ninety per cent are operating on the Strowger system.

Southern Bell Makes Three State Divisions

Birmingham, Ala.—The state of Alabama has been made a separate division of the Southern Bell, with headquarters at Birmingham. Col. W. E. Bare has been appointed Division Manager for Alabama. Georgia has been made a separate division also, with G. C. Beck as Manager. David Laird was made Division Manager for the Florida division.

"Staged" Exhibit Puts Shekels in Cook's Coffers

Chicago, Ill.—It pays to introduce a novelty into convention exhibits. The Cook Electric Co. can confirm that statement by referring you to the volume of business booked at the recent Independent convention in Chicago. Cook set its protected and unprotected terminals, and substation and lightning arresters with a background of a rich black velvet stage. A brilliant, concealed lighting effect focused vision on the Cook products. The unique and favorable impression of the draped staging was received with enthusiastic comment by convention visitors.

LYON STEEL PRODUCTS

The Lyon Head Set Cabinet is just one of those Lyon Steel Products designed especially for telephone requirements.

If it is something in which to store things — Lyon has it.

The nearest District Office can tell you.

LYON METALLIC MFG. CO.
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NEW YORK CHICAGO BOSTON DETROIT
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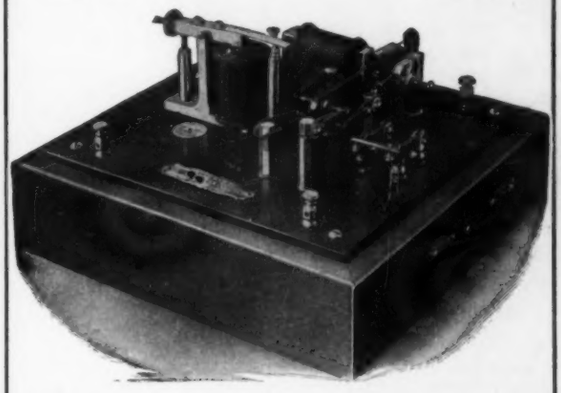
LOS ANGELES ROCHESTER

A GOOD POLE CHANGER
with our guarantee that it would **make good,** was what we started with.

Warner Pole Changers
are **keeping our word** with 25,000 users.
Think it over—
WARNER ELECTRIC CO.
MUNCIE INDIANA



WARNER

French TELEPHONE BATTERIES
FRENCH BATTERY & CARBON COMPANY
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STRAND STEEL WIRE
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White Cedar Poles
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"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.
SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.
Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.
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Practical Plant Problems

Chapter IX—Cable Splicing Methods Illustrated

By Charles W. McKay, Associate Editor

In this installment, we will discuss cable splicing problems.

The case illustrated in Fig. 22 is very simple. All of the cables are of 200 pair capacity. The original cable (No. 1) is carried to the exchange limit. This cable has a number of 50-pair distribution cables spliced onto it. Cable No. 1 becomes "congested"—and, by the simple expedient of extending a relief cable to point "A" and making one "cut" and "throw" relief is at once provided.

When cables No. 1 and No. 2 become congested, cable No. 3 is extended to point "B," and the process repeated.

We then have three 200-pair cables feeding the district. If the plant engineer's original hypothesis has been correct, no further relief will be required—and the territory will be amply cared for.

Now let us consider a more complicated case, as illustrated in Fig. 23. The same method is adopted and a detailed explanation will not be necessary.

This method of providing relief is known as the "non-diminishing" method. We will consider it further in the January issue.

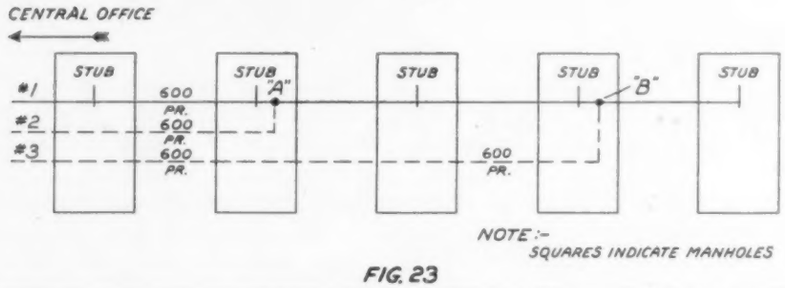

FIG. 23

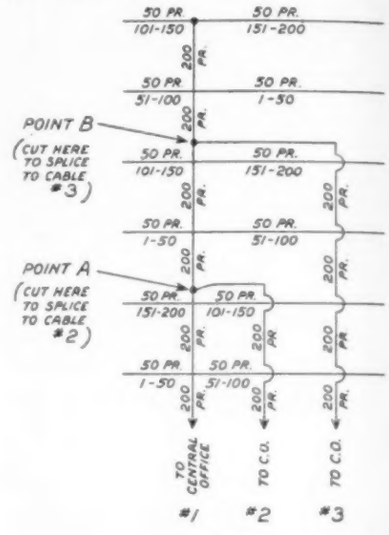

FIG. 22

JAMES C. KELSEY DEAD

Popular Writer and Prominent Figure in Telephone Industry Passes Away

Chicago, Ill.—James C. Kelsey, prominent and popular in the telephone industry for the past twenty years, died of double pneumonia at Columbus Memorial hospital, Chicago, December 8. Although he had been in ill health since suffering a nervous break down five years ago, his last sickness was very brief and the end came as a great shock to his many friends.

"Jim" Kelsey was known all over the world as the most interesting writer in the telephone business. His last series of articles appeared in Telephone Engineer, the early part of 1922, and were as good as ever. Every one relished them—and was happy that Kelsey had come back. At that time, he was in California, acting as secretary of the Independent telephone association of that state. In June, he came East, feeling strong and happy. It proved, however, the last flash of his always admirable fighting spirit. A relapse occurred and he went to Galveston, Tex. in the fall to make another stand for his health. He returned but recently—to die.

James Cezanne Kelsey was born at Leavenworth, Kans., May 18, 1872. He was educated at the University of Minnesota and Kansas State University, graduating from the latter school's course in electrical engineering. He served in the order named: first as city electrician of Hiawatha, Kans., (where his remains were interred last week); then with the Emerson Electrical Mfg. Co., St. Louis; the Fort Wayne, (Ind.) Electrical Corp; and the Northwestern Bell Telephone exchange at Minneapolis, for which he was power switchboard man. In 1901, he became general superintendent of the Duluth Telephone Co., Mesaba Telephone Co. and Douglas Telephone Co., Bell auxiliary companies in and around Duluth, Minn. The following year, he became professor of telephone engineering at Purdue University, Lafayette, Ind., which course he established. There his acquaintance with Independent telephony began. He was on the jury of award at the world's fair in St. Louis and later handled the valuation of the Keystone Telephone Co., Philadelphia. He also acted as expert for Kansas City, Mo., in what is believed to be the first telephone rate case in this country. In 1905 he became sales manager of the Kellogg Switchboard & Supply Co., Chicago. Nine years later, he became vice president of Telephony Publishing Co., retiring in 1919 because of ill health.

James C. Kelsey was one of the field's most active spirits. Ability, energy and honesty were three of the most outstanding among his many splendid traits. He participated in every big telephone meeting up to the very last and was probably the best known single character of his day and field. He was a mason and an elk.

The funerel services were held, privately, at his late home, 1131 Lunt ave., Chicago, Dec. 10. A widow; son, James, and daughter, Elizabeth, survive him.

Fort Wayne, Ind.—A new exchange building to cost $75,000 is to be erected by the Home Telephone & Telegraph Company.

MANUFACTURERS OF

9 Duct

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We carry large stocks of round singles, square single, two, three, four, six and nine duct, in standard and short lengths, splits, mitres and bends.

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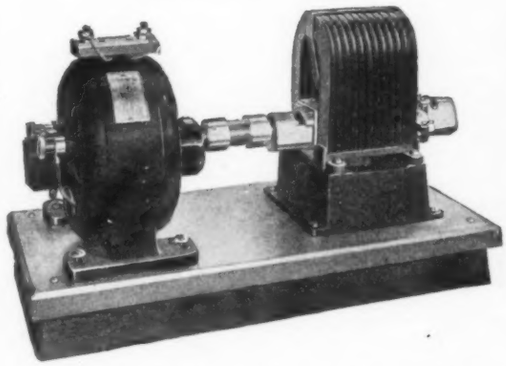

Our MAGNETO-RINGING MOTOR GENERATORS cost little to install — and less to maintain.

BUT—
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The Holtzer-Cabot Electric Co.

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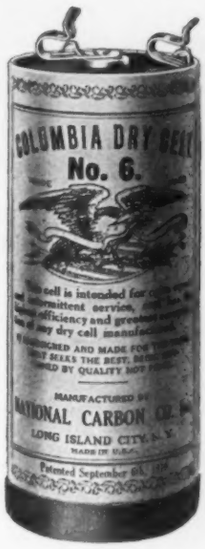

On the telephone line, batteries have to "be good" in two ways. They must be right smart and snappy when it comes time to speak their piece—and deader'n a doornail while the receiver's on the hook. For they must live and serve for a long, long time. Telephone men know—and they always specify Columbia Gray Labels in order to profit through less cost per month of service. Fahnestock Spring Clip Binding Posts at no extra cost.

Columbia
Telephone Batteries
"less cost per month of service"

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Inc.
Long Island City, N. Y.
ATLANTA CLEVELAND CHICAGO
KANSAS CITY SAN FRANCISCO

Canadian National Carbon Company, Ltd., Toronto

JOHN ZIETLOW DEAD

Veteran Chief of Dakota Central Mourned; Fighting, Self-Made Man

John L. W. Zietlow, founder of the Dakota Central Telephone Co., died at his home in Aberdeen, So. Dak., November 14. Mr. Zietlow built the first telephone exchange in South Dakota. He was a member of the Telephone Pioneers of America, and a national figure in the telephone industry.

Surviving him are his widow, son, J. Ford Zietlow, and two daughters, Mrs. A. E. Chilson of Minneapolis and Mrs. R. S. Hamilton of Baker, Mont. J. Ford Zietlow is general superintendent of the Dakota Central Company.

Mr. Zietlow's loss to the industry is mourned far beyond the limits of the organization which he built.

He was born in northern Germany in 1850, learned the watchmaker's trade, and came to this country when 17 years old. He worked for a Wisconsin farmer for $100 a year and board, and out of his first year's wages he saved $35. In 1872, while working in a blacksmith shop he first learned of electricity. One year later he met with an accident while working in a sawmill, which caused the loss of his right arm. Added to this misfortune, the bank in which he had his savings, failed. Undaunted, however, he worked his way through Naperville, Ill., College.

Afterwards he worked at scaling lumber, took up a homestead, and in 1880 went to work for the Northwestern Manufacturing and Car Company, prison contractors at Stillwater, Minn., where he experimented for the first time with telephone and electric clock systems.

It was in 1886 that he built the first telephone exchange in Aberdeen. This exchange, which had sixty-five subscribers, was the nucleus around which grew the Dakota Central Company which has a capital stock of $5,000,000, owned by 450 stockholders. On the payroll of the company are 450 employees. The company serves the territory east of the Missouri river in South Dakota, part of Minnesota and several counties in North Dakota.

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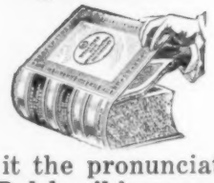

Be it the pronunciation of **Bolsheviki** or **soviet,** the spelling of a puzzling word—the meaning of **blighty, fourth arm,** etc., this **Supreme Authority—**
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J. C. Kirkpatrick, Pole Magnate, Dies at Escanaba

Escanaba, Mich.—J. C. Kirkpatrick, founder and president of the National Pole Co., died here on November 17. He was 61 years old at the time of his death. Mr. Kirkpatrick had lived to see many of his ambitious plans for his own company and for the pole industry in general, consummated. He was a towering figure in the industry, one of the stalwart old guard of a business that demanded real men to put it on its present basis.

His own company attained the national character that he intended for it when its name was picked. As a leader of men he was recognized by his fellows in being made president of the Northern White Cedar Assn. in 1917. He was active in the affairs of that association.

As "Kirk" he was "hale, fellow, well met," to a host of luminaries and lesser lights in the pole industry, in the telephone business and in other fields where his activities took him. His passing at a time when his powers were at their zenith is the cause of deep regret to the many by whom he was honored and beloved.

His social activities were many and varied. He was a member of the Minneapolis Club, and the Chicago Athletic Assn. and Union League Club of Chicago, as well as many other organizations.

McAnge Promoted to Presidency of Allen Properties

Corinth, Miss.—W. N. McAnge, Jr. has been made president of the Allen properties, the Sun Telephone Co. Mr. McAnge has been the operating head of the system for six years. He enjoys a high reputation in his home community as a constructive factor in the community's life. When he arrived on the job in Corinth, there were fewer than 700 stations owned by the Allen system. Now the compony has 5,000 stations in eighteen counties of Mississippi, Alabama, and Tennessee, with a capital investment of almost $500,000. Other officers chosen at the directors' meeting were: Vice President, J. H. Grover; Secretary-Treasurer, B. Ashley Grant; assistant Secretary-Treasurer, H. J. Newbill.

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Absolutely pure water for less than one or two cents a gallon, no matter how polluted your supply of water may be. For drinking, chemical or battery purposes the Peerless stills give you the best, ample supply at lowest cost.
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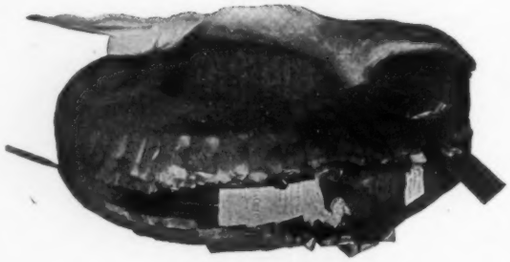

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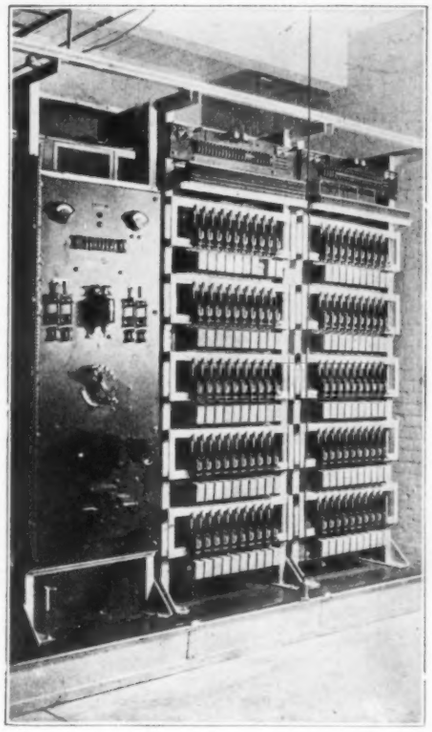

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The C. A. X. is a simple automatic switchboard for the small village or rural community, arranged to operate without attention except for short visits at intervals of one or two weeks. It is simple enough to be entirely reliable at all times, economical to install and easy to maintain. It is complete enough to be adequate for all small-town traffic or service requirements.

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The Dollar

The daily actions of most of us are influenced by the messages received over the telephone, and yet few of us stop to think of the men and women, and the mechanisms, which help to make that daily service possible.

Maintenance, repairs, and the work of handling calls, must constantly be carried on in good times or in bad, and they must be paid for, in order that your telephone service may be continued.

The average dollar will buy to-day less than two-thirds of what it would buy before the war. This means that it costs, on the average, half as much again to buy most of the things that are necessary for keeping the country going; but the advance in telephone rates is far less than this average.

In fact, gauged by the present purchasing power of the dollar, telephone service in the country as a whole is costing the subscriber less than it did in 1914.

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